ERDC/GSL SR-XX-XX

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US Army Corps of Engineers®
Engineer Research and Development Center

Pavement-Transportation Computer Assisted Structural Engineering (PCASE) User Manual

Version 2.08

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Introduction

What is PCASE?

Web Link
More Information on PCASE can be found at www.pcase.com.

PCASE, or "Pavement-Transportation Computer Assisted Structural Engineering", is a software program that incorporates all transportation design and evaluation criteria into a stand-alone software package. This package allows research to be modularized into a set of scalable and reusable software components, which are then combined to create the PCASE desktop system designed to be installed on a single computer. PCASE calculations are based on the following UFC manuals.

Criteria	Old Manuals			New Manual
	Army	Air Force	Navy	Unified Criteria
Pavement Design for Airfields	EI02C014	AFJMAN 32-1014	NAVFAC DM 21-10	UFC 3-260-02
Pavement Evaluation for Airfields	TM 5-826-1,2,3,4,5,6,8	AFM 88-24 Ch. 1,2,3,4,5,8 AFM 88-7,8 AFJMAN 32-1036	NAVFAC DM 21.7	UFC 3-260-03

Helpful Hint
The manuals are downloaded with the PCASE software. Just open the "Help/Utilities" button once the software is installed.

What does PCASE do?

PCASE software automates day-to-day engineering tasks by giving engineers a software tool. This process allows engineers to try multiple design or evaluation scenarios without having to start over each time. While every engineer using PCASE should have a thorough understanding of the pavement design and evaluation process, the software gives them a tool to automate repetitive tasks. Secondly, PCASE is the tool for technology transfer of pavement-transportation criteria. What good is research that never gets used? PCASE puts the volumes of UFC criteria into a single stand-alone application that rests as an icon on the users' desktop.

PCASE Capabilities

PCASE Windows-based computer programs include rigid and flexible airfield design by conventional and layered elastic methodologies, rigid and flexible road design, as well as railroad evaluation. The website lists the PCASE capabilities as

Road pavement design & evaluation
- Flexible pavement
- Rigid pavement

Airfield pavement design & evaluation
- Flexible pavement
- Rigid pavement
- Unsurfaced areas
- Mat (Light, Medium, Heavy)

Other Utilities
- Design Curve Generator
- Decision Tree Module
- Aircraft classification numbers (ACN)
- Dynamic Cone Penetrometer (DCP)
- Vehicle Editor

Chapter 1 – Getting Started

Hardware Requirements

Before the user installs PCASE software they should make sure their computer falls within these ranges of specifications. PCASE recommends a powerful machine because the software is calculation intensive and the faster the machine the faster the user will get results.

Hardware/Software	**Minimum**	**Recommended**
Processor	300 MHZ	3 GHZ
Video Card	Standard VGA	16 MB Graphics Card
CDRom	12x Speed	40x Speed
Monitor Resolution*	1024x768	1024x768
Memory	64 MB	256 MB
Sound Card	Any	Any
Microsoft Office**	2000	2000 or Higher
Monitor Size	15”	21” or Higher

* Screen space is very important in PCASE 2.0 a minimum resolution of 1024x768 is necessary to see all the windows.

** All reports within PCASE are generated using Microsoft Office 2000 Professional. This reporting system gives superb quality.

Helpful Hint
PCASE will run on any machine, old or new, running Windows 2000 or later. The newer the machine the faster the results will process.

Downloading PCASE

To download the PCASE software, open your Internet browser and type in the URL www.pcase.com”.

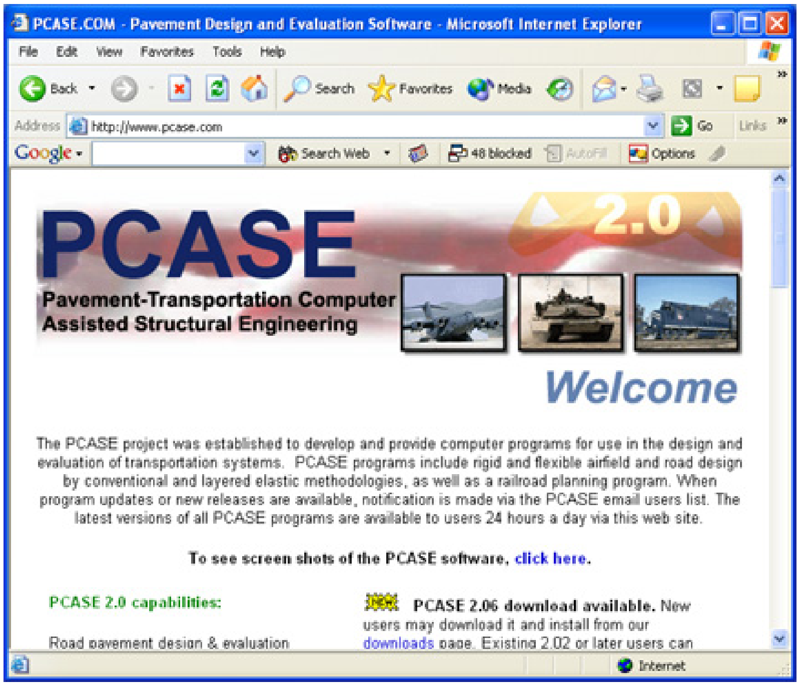


Figure 1-1

Scroll to the bottom of the page and click the button “Downloads”. The screen will then ask for your email address. One the email address is entered, press the “Click to continue” button. If the user is a first time registrar then the website will ask them for a complete registration form. This is a one-time process. The next time the user returns to the website, they will be asked for their email address, but will not be asked to fill out the form. Once the form is completed click the button “Click Once to Submit Information”. This will store the data in the PCASE user database. The user is then navigated directly to the downloads’ page. The user should then scroll down the page until they see a table that looks like Table 1.

Table 1-1

Revision Number	Release Date	Comments
PCASE 2.08 Baseline Release	10 Mar 2005	Download Site 1 – Vicksburg Download Site 2 - Orlando

Click on the link for either one of the download sites to begin the download process. As soon as the user clicks the link a box similar to figure 1-2 will appear.

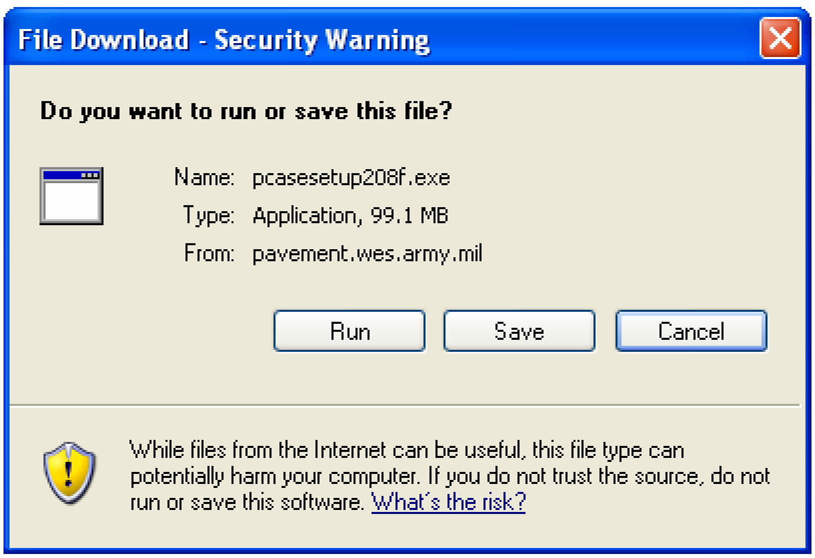


Figure 1-2

The user should then click "Save" and store the PCASE installation file named "pcasesetup208f.exe" in a directory on their hard drive. This does not install PCASE, this is simply downloading the installation file to your local machine.

PCASE Installation

Once the file is downloaded, the user can close the web browser and then go to "My Computer" or "Explorer" on their computer and browse to the folder that contains the file they just downloaded. Once the user has found the file, double-click the file to start the installation process. Most users can simply select "Next" on all screens without any changes. Once the installation is complete, an icon will appear on the users' desktop called "EMS Desktop" that looks like figure 1-3. Double click this icon to start using PCASE.

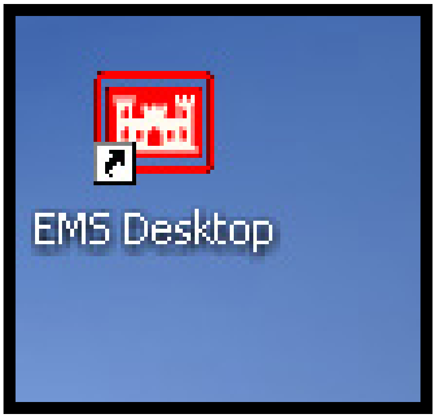


Figure 1-3

Starting a Project File

Once the user opens the PCASE software, a "Welcome to PCASE" window will appear on the screen with the tab headings of Create New Project, Open Existing Project and Recent Projects. See Figure 1-4.

Figure 1-4

Helpful Hint
Clicking on the Cancel button on the "Open" Window will open the project file you used last.

To start a new project, you can double-click on the red icon "Create New Project" or click on the "Open" button on the bottom right of the Open window. In the Enter New File Name window, enter your project file name. For this example, use Polk.pvr. You don't need to add the .pvr extension it will be automatically added to your entered file name. This creates a new database with a clean inventory, ready for data entry.

To open an existing project, click on the Open Existing Project tab. Scroll to the project file (the .pvr file, not the folder of the same name) and double click on the file name or highlight the file name and click on the Open button.

To open a file recently created, click on the Recent Projects tab. Scroll to the project file and double click on the file name or highlight the file name and click on the Open button.

In the Open window you can also access the Help System by clicking on the Help button. The Help System gives help topics through a table of contents, index or search. The Getting Started button also takes you to the Help System but takes you directly to the Tutorials.

Using the Help/Utilities

To open the Help/Utilities select the "Help/Utilities" button from the PCASE toolbar as seen in figure 1-5. Once the button has been selected a screen as seen in figure 1-6 will open. There are 6 sections on this screen, each of which are explained below.

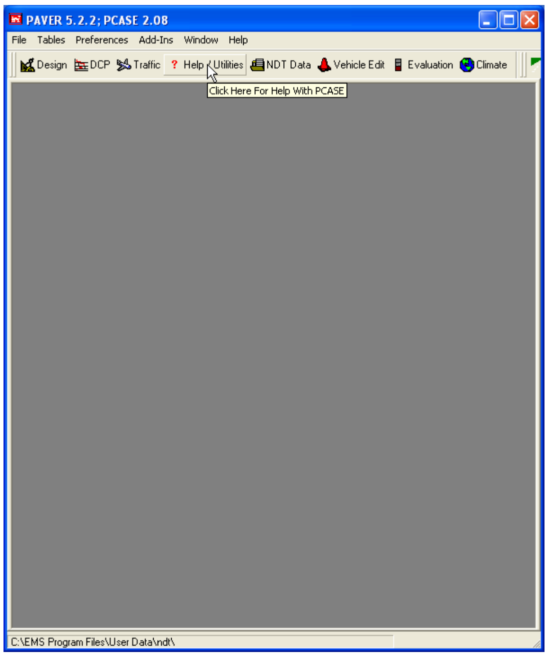


Figure 1-5

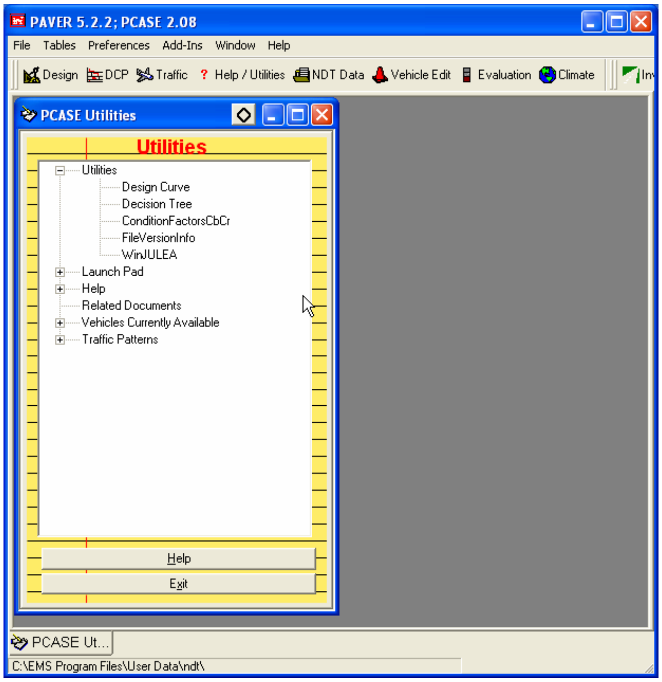


Figure 1-6

Utilities

This section is reserved for modules that the user may need from time-to-time, but do not belong in the main PCASE toolbar.

Launch Pad

This section contains several PCASE utilities for file management. See Figure 1-7.

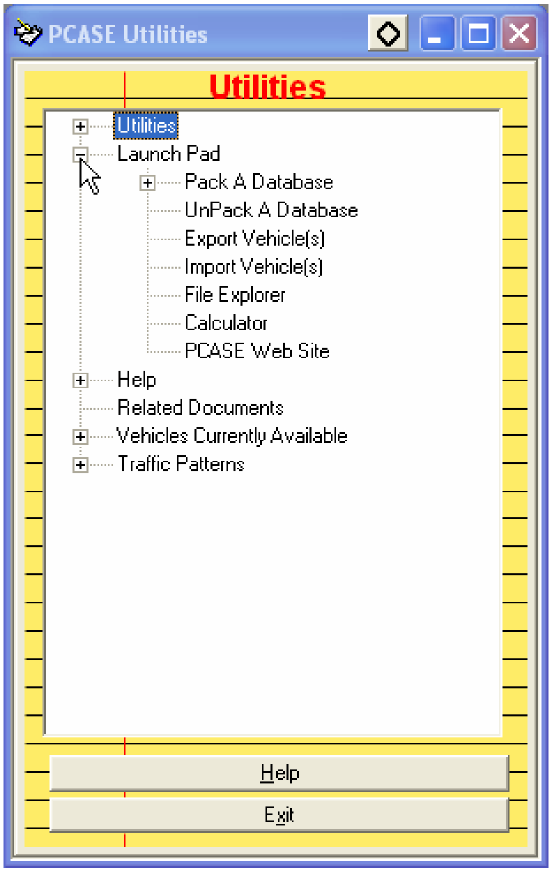


Figure 1-7

Pack A Database – This option will allow the user to compress a project file into one single ZIP file. To start the pack file process, click the "+" plus sign next to the "Pack A Database" node. This will list all the projects. See Figure 1-8. Then user can then click on the project file they wish to "Pack". When the user clicks on the project.pvr file, PCASE will ask the user if they wish to continue packing the data. See Figure 1-9. After the user selects "Yes" the software notifies the user that their project has been successfully packed. The zip file is always put into the root c:\ directory. See Figure 1-10. This file can then be emailed to a co-worker or to tech support.

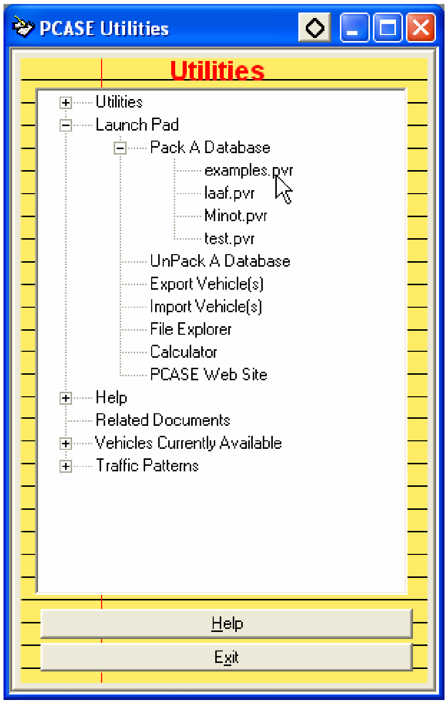


Figure 1-8

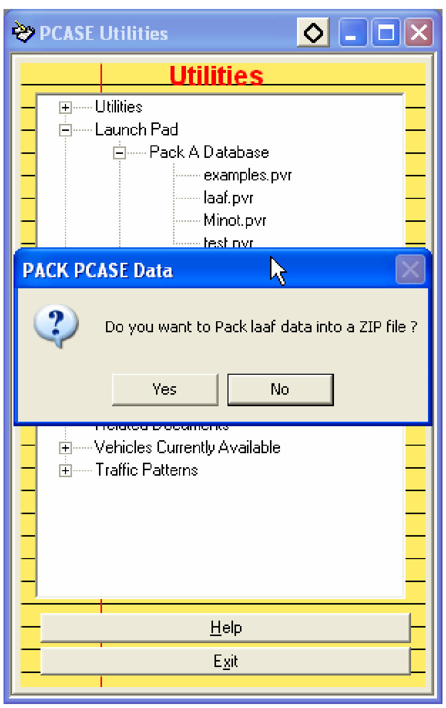


Figure 1-9

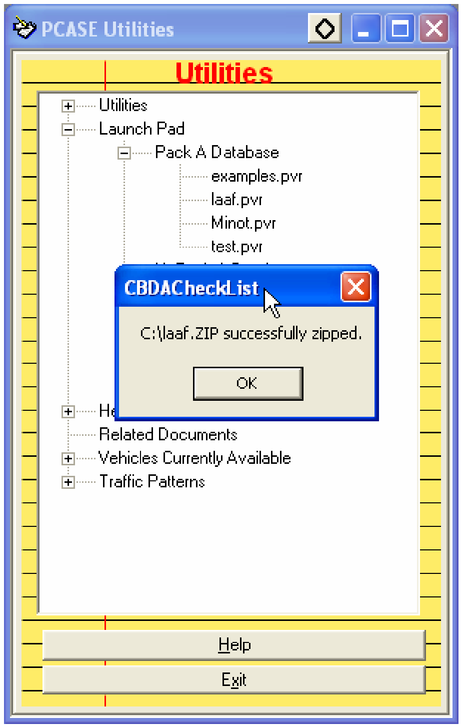

PCASE Utilities
Utilities
Utilities
Launch Pad
Pack A Database
examples.pvr
laaf.pvr
Minot.pvr
test.pvr
CBDACheckList
C:\laaf.ZIP successfully zipped.
OK
Related Documents
Vehicles Currently Available
Traffic Patterns
Help
Exit

Figure 1-10

Chapter 2 – Running the Pavement Design Module

Create a Traffic Pattern First

All pavement designs are based on a planned set of traffic. Before beginning a pavement design, the user must first build a traffic pattern. See appendix "A" in this manual to build a traffic pattern. Then continue with the next step, "Starting the Design Module" below.

UFC 3-260-03 Ref

"Determine Design Traffic" Page 4-6.

"Airfield Traffic Data" Page 2-4

Starting the Design Tool

Now that the user has created a traffic pattern, they are ready to open the design module to do a pavement design. If the user looks in the toolbar, they will see a button labeled "Design" as in figure 2-1. Click this button to open the design module.

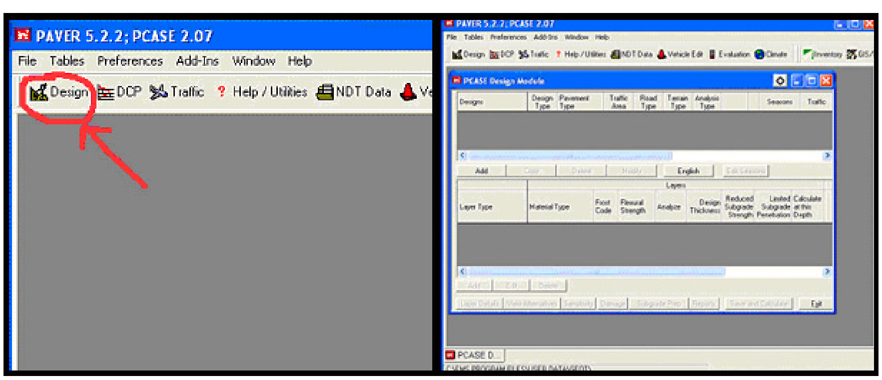


Figure 2-1

Building A New Design

Clicking the Add button on the design module displays a form allowing the user to create a new pavement design. See Figure 2-2 below.

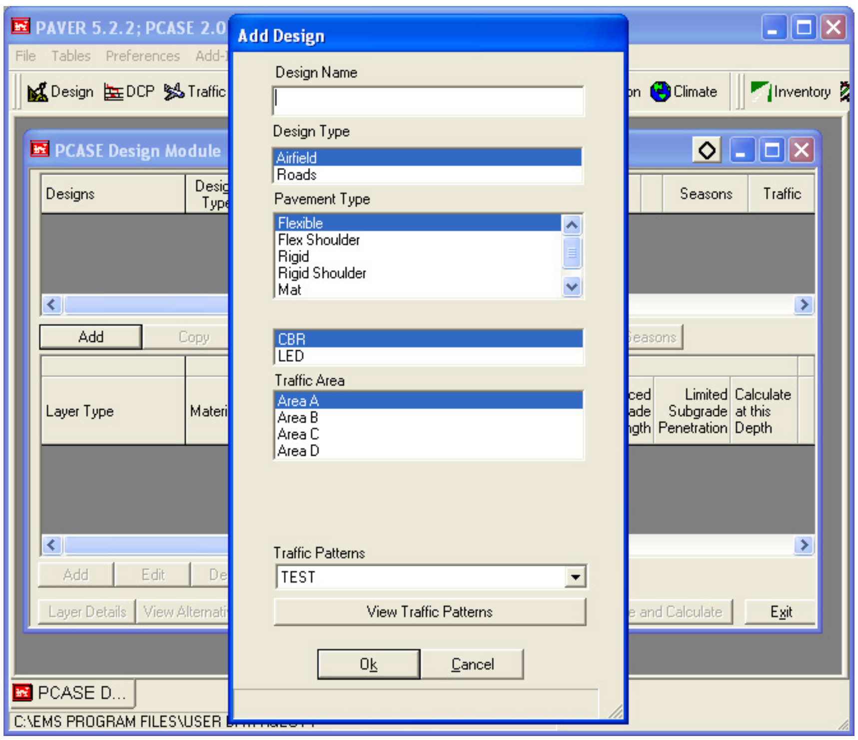


Figure 2-2

The following fields are required for this screen.

Design Name – This is a user defined description of the design that they are building. For example if the user is designing a new apron for Hunter Army Airfield, they may put “Hunter AAF” as the design name.

UFC 3-260-02 Ref

Design Type – Select if this design is for an airfield or a road.

LED Design is Chapter 19 page 19-1

Pavement Type – Select if this design should be performed using Flexible, Rigid, Unsurfaced, Mat, or shoulder criteria.

UFC 3-260-02 Ref
Traffic Area for ARMY Pavements Page 2-1

Analysis Type – Select if this design should be performed using Empirical (CBR) (Page 10-1 UFC 3-260-02) or Layered Elastic (LED) (Page 11-1 UFC 3-260-02) criteria.

Traffic Area for Air Force Pavements Page 3-1

Traffic Area – For Airfield pavements select the traffic area for this design. See page 2-1 for Army, 3-1 for Air Force and page 4-1 for Navy of UFC 3-260-02 for Traffic Area descriptions.

Traffic Area for Navy/Marine Corp Pavements Page 4-1

UFC 3-250-01 Ref
Terrain Types for Road Designs Page 3-2

Road Type – For Road designs (See Figure 2-3), select if the design is for a road, street or parking area. These definitions can be found on page 1-1 UFC3-230-18FA "Geometric Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas"

Terrain Type – For Road designs, select if the design is for rolling, flat or mountainous terrain. These definitions can be found on page 3-3 UFC3-230-18FA "Geometric Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas"

UFC 3-260-02 Ref
Flexible Pavement Design
Page 10-1

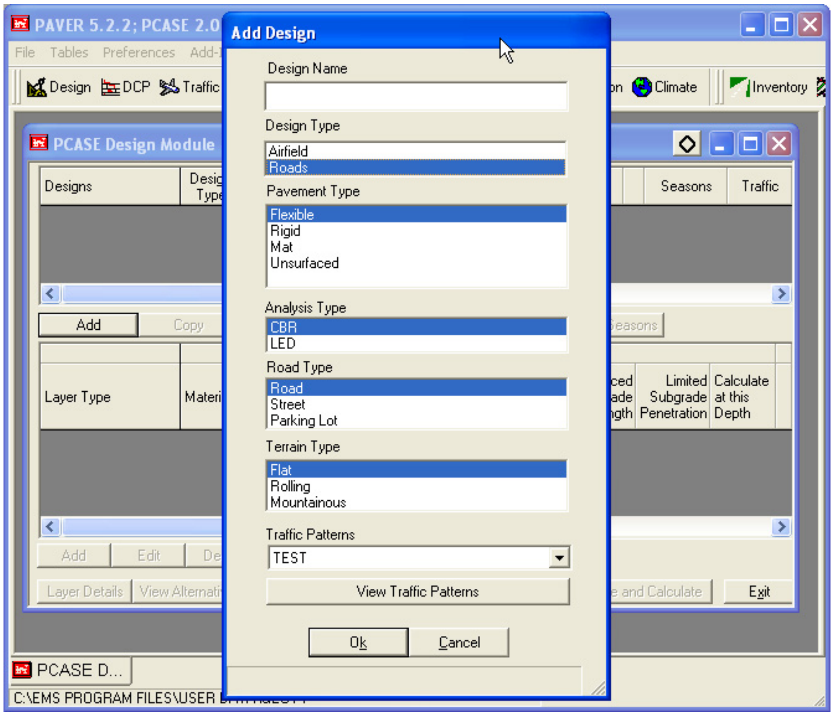


Figure 2-3

Creating a Flexible Pavement Design – CBR Criteria

If the user builds a flexible pavement using CBR (Empirical) criteria then they will see a series of screens allowing them to build the default layer structure for a flexible pavement. The descriptions for each of the inputs are below figure 2-4.

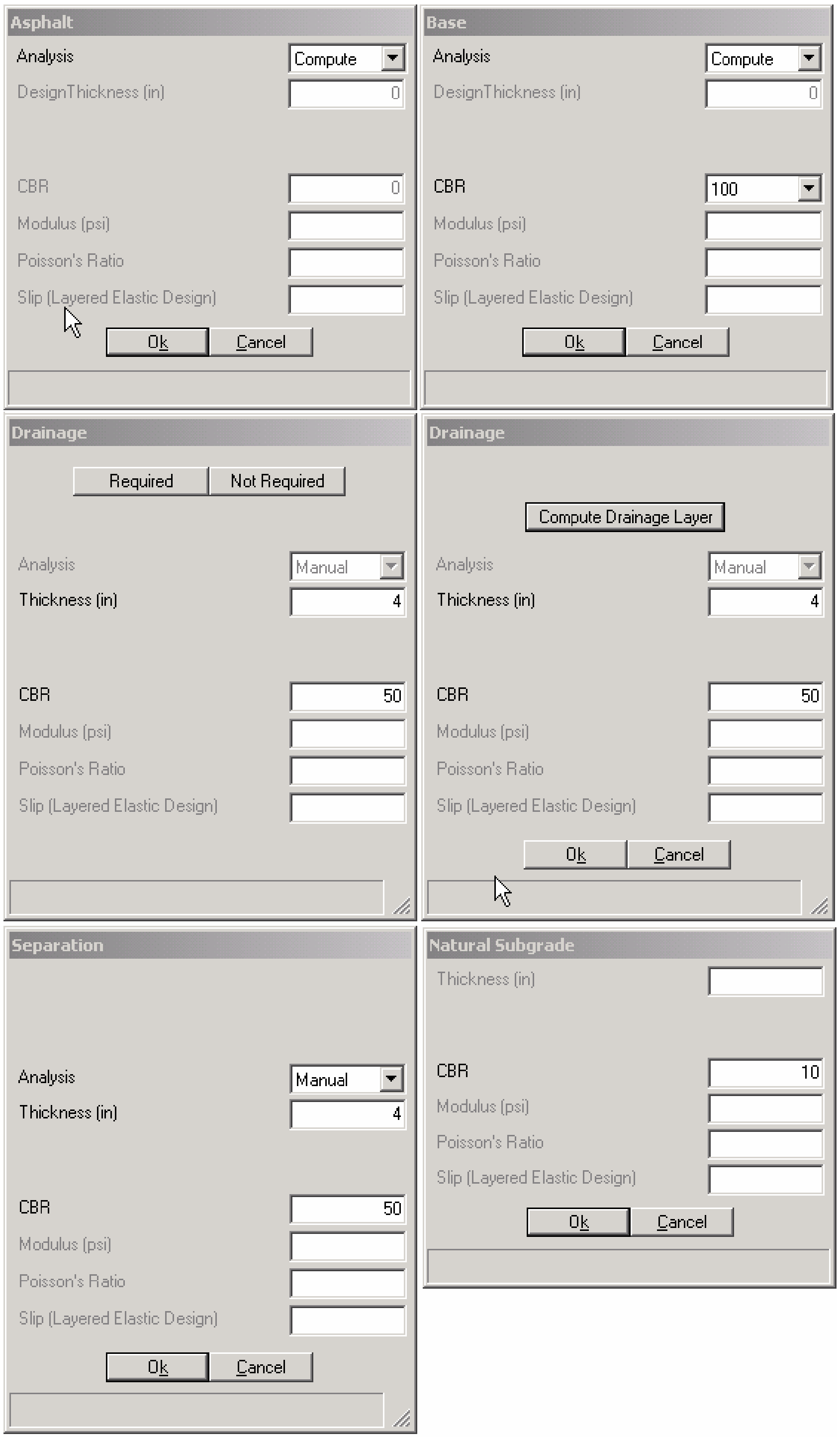

Asphalt
Analysis
Compute
DesignThickness (in)
0
CBR
0
Modulus (psi)
Poisson's Ratio
Slip (Layered Elastic Design)
Ok
Cancel
Base
Analysis
Compute
DesignThickness (in)
0
CBR
100
Modulus (psi)
Poisson's Ratio
Slip (Layered Elastic Design)
Ok
Cancel
Drainage
Required
Not Required
Analysis
Manual
Thickness (in)
4
CBR
50
Modulus (psi)
Poisson's Ratio
Slip (Layered Elastic Design)
Drainage
Compute Drainage Layer
Analysis
Manual
Thickness (in)
4
CBR
50
Modulus (psi)
Poisson's Ratio
Slip (Layered Elastic Design)
Ok
Cancel
Separation
Analysis
Manual
Thickness (in)
4
CBR
50
Modulus (psi)
Poisson's Ratio
Slip (Layered Elastic Design)
Ok
Cancel
Natural Subgrade
Thickness (in)
CBR
10
Modulus (psi)
Poisson's Ratio
Slip (Layered Elastic Design)
Ok
Cancel

Figure 2-4

Analysis – Most of the time the user should leave this field as the default of "Compute". This tells the PCASE software to calculate the thickness requirements. This could be changed to "Manual" if the user wants to manually construct one of their layers to an exact thickness (i.e. to match up to existing pavement) and have the software compute the other layers to compensate.

CBR – California Bearing Ratio. This is the strength value for the layer.

EI-02C202 - Subsurface Drainage Page 1

Drainage – The drainage layer within a design structure can be optional depending on the situation. If a drainage layer is not required then click the button "Not Required" and the software will bypass the drainage requirements. If the drainage layer is required the click the "Required" button and the software will go to a second screen that has the button for "Compute Drainage Layer". *See Appendix D – Computing a Drainage Layer*

Compute Drainage Layer – *See Appendix D – Computing a Drainage Layer*

Thickness – Usually required as drainage layer or separation layer inputs. This value can be calculated or entered manually. This field will also be required if the user selects to set the thickness of the asphalt or base course manually.

UFC 3-260-02 Ref
Rigid Pavement Design Page 12-1

Creating a Rigid Pavement Design – K Criteria

If the user builds a Rigid pavement using "K" (Empirical) as the criteria then they will see a series of screens allowing them to build the default layer structure for a Rigid pavement. The descriptions for each of the inputs are below figure 2-5.

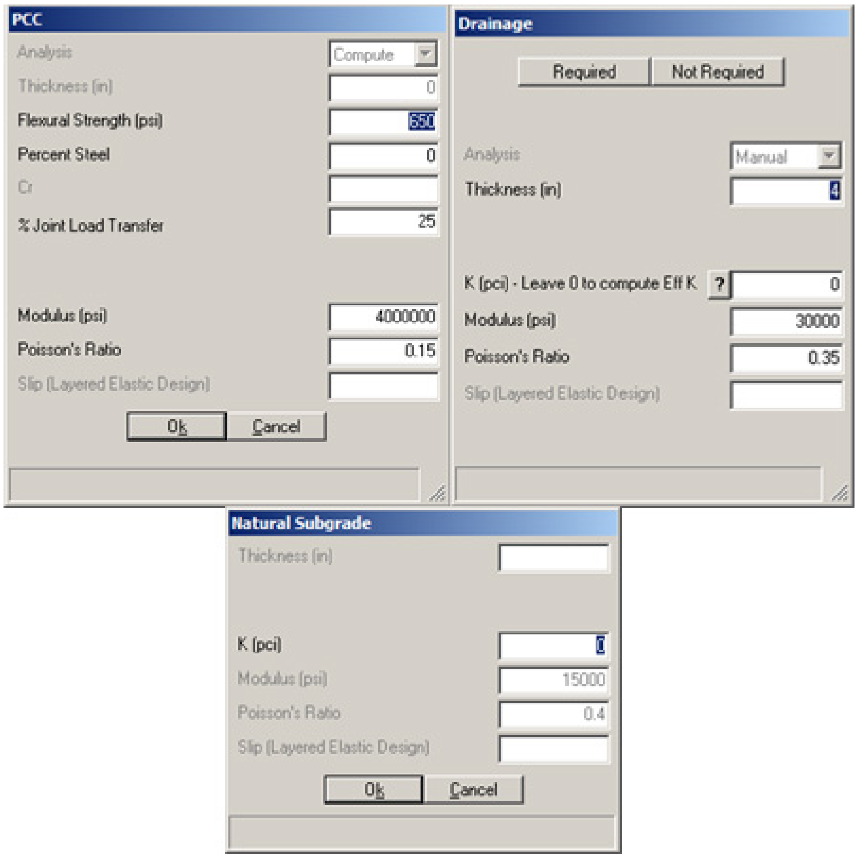


Figure 2-5

UFC 3-260-02 App "E" Ref
Determination of Flex Strength

Flexural Strength – Enter the flexural strength of the new concrete to be placed. Procedures for determining the flex strength of the PCC can be found in appendix E of UFC 3-260-02.

UFC 3-260-02 Ref
Reinforced Concrete Pavement Design Page 13-1

Percent Steel – If the new concrete will be reinforced, the user should enter the percent steel used for the reinforcement.

UFC 3-260-02 Ref
Load Transfer Described Page 12-1

% Joint Load Transfer – For design, a load transfer value of 25 percent is routinely used as a reasonable approximation of the load transfer measured over time on the types of joints approved for use in Army and Air Force airfields. The actual load transfer at a joint will vary depending on joint type, quality of construction, slab length, number of load repetitions, temperature conditions, etc. The design charts in this chapter were developed based on a 25 percent load transfer value. If adequate load transfer is not provided at the joints of trafficked slabs, the pavement should be designed for no load transfer using the PCASE pavement design program that allows direct input of the load transfer value or the gross load used in the design charts in this chapter should be increased by 1/3 to remove the load transfer effect.

Modulus – modulus of elasticity of concrete, usually taken as 27,575 MPa (4 × 106 psi)

UFC 3-260-02 Ref
Typical PR for pavement materials Page 11-7

Poisson's Ratio – Enter the Poisson's Ratio of the concrete material.

EI-02C202 - Subsurface Drainage Page 1

Drainage – The drainage layer within a design structure can be optional depending on the situation. If a drainage layer is not required then click the button "Not Required" and the software will bypass the drainage requirements. If the drainage layer is required the click the "Required" button and the software will go to a second screen that has the button for "Compute Drainage Layer". *See Appendix D – Computing a Drainage Layer*

Thickness – Usually required as drainage layer or separation layer inputs. This value can be calculated or entered manually. This field will also be required if the user selects to set the thickness of the asphalt or base course manually.

UFC 3-260-02 Ref
Layered Elastic Design For Flexible Pavements Page 11-1

Creating a Flexible Pavement Design - Layered Elastic Criteria

The primary difference between an empirical design and a layered elastic design is the use of "modulus" values for layer strengths instead of CBR values. Notice the screens below, when the software steps the user through the process of building a flexible layer structure, the software ask for the modulus values for each layer. If the user builds a Flexible pavement using "LED" (Layered Elastic) as the criteria then they will see a series of screens allowing them to build the default layer structure for a Layered Elastic Flexible pavement. The descriptions for each of the inputs are below figure 2-6.

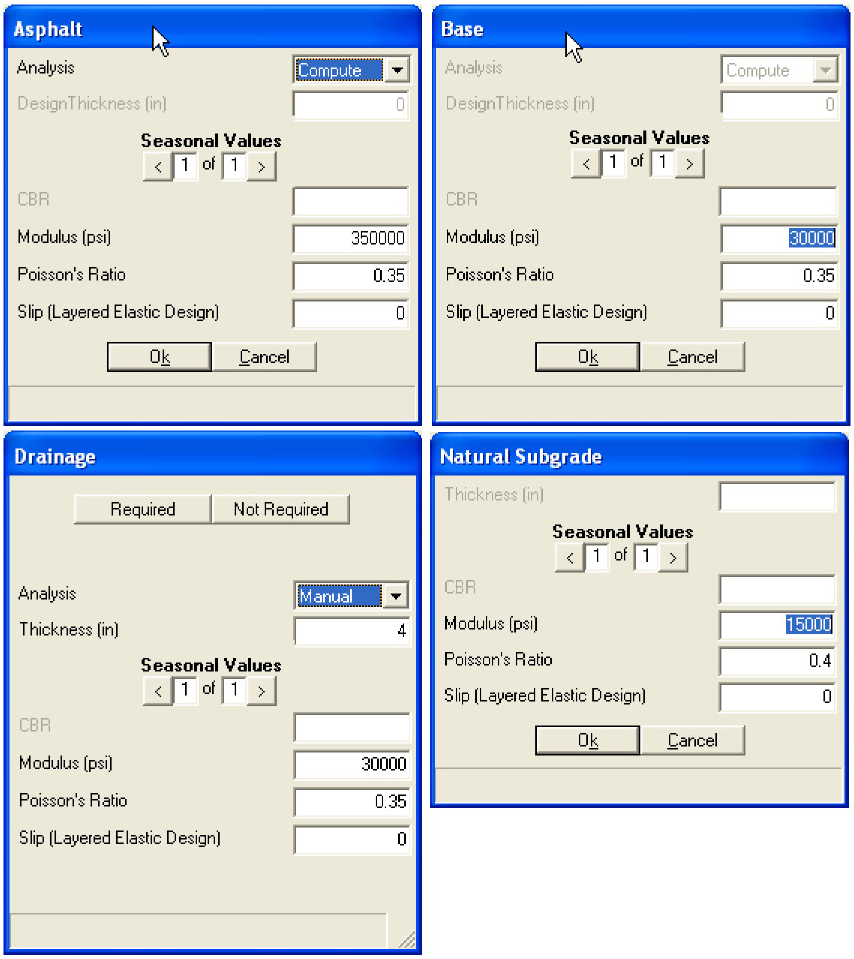


Figure 2-6

Analysis – Most of the time the user should leave this field as the default of "Compute". This tells the PCASE software to calculate the thickness requirements. This could be changed to "Manual" if the user wants to manually construct one of their layers to an exact thickness (i.e. to match up to existing pavement) and have the software compute the other layers to compensate.

CBR – California Bearing Ratio. This is the strength value for the layer.

Drainage – The drainage layer within a design structure can be optional depending on the situation. If a drainage layer is not required then click the button “Not Required” and the software will bypass the drainage requirements. If the drainage layer is required the click the “Required” button and the software will go to a second screen that has the button for “Compute Drainage Layer”. *See Appendix D – Computing a Drainage Layer*

Compute Drainage Layer – *See Appendix D – Computing a Drainage Layer*

Modulus – modulus of elasticity of concrete, usually taken as 27,575 MPa (4 × 106 psi)

Poisson’s Ratio – Enter the Poisson’s Ratio of the concrete material.

Thickness – Usually required as drainage layer or separation layer inputs. This value can be calculated or entered manually. This field will also be required if the user selects to set the thickness of the asphalt or base course manually.

Creating a Rigid Pavement Design - Layered Elastic Criteria

UFC 3-260-02 Ref
Layered Elastic Design for Rigid Pavements Page 19-1

If the user builds a Rigid pavement using “LED” (Layered Elastic) as the criteria then they will see a series of screens allowing them to build the default layer structure for a Layered Elastic Rigid pavement. The descriptions for each of the inputs are below figure 2-7.

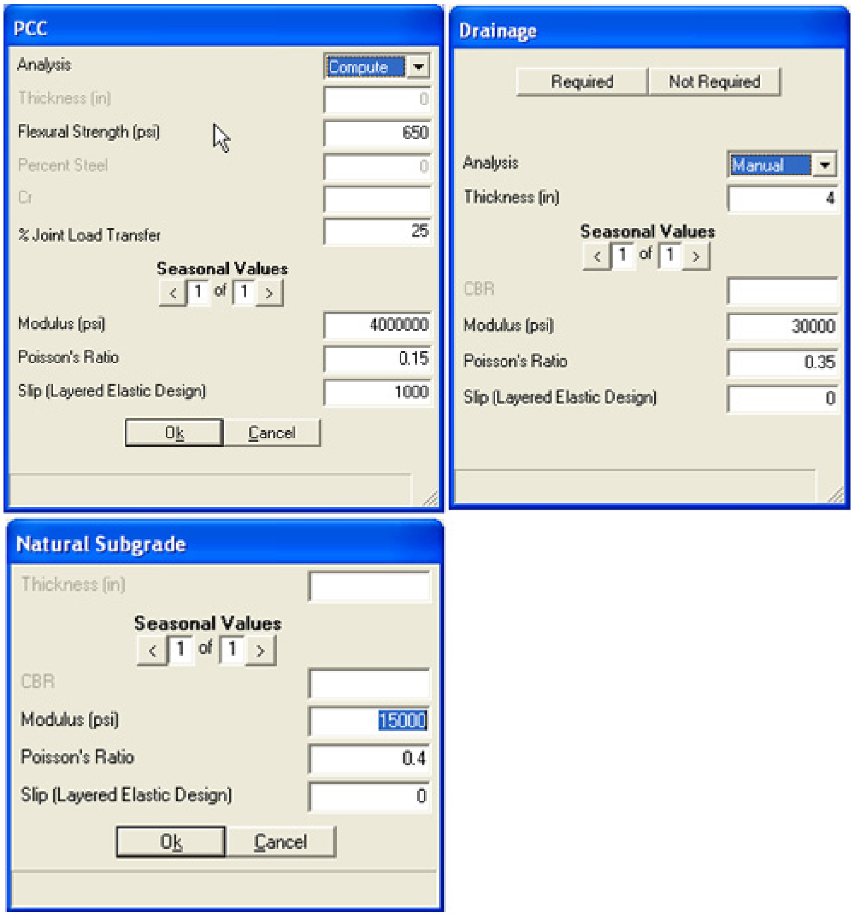


Figure 2-7

Analysis – Most of the time the user should leave this field as the default of “Compute”. This tells the PCASE software to calculate the thickness requirements. This could be changed to “Manual” if the user wants to manually construct one of their layers to an exact thickness (i.e. to match up to existing pavement) and have the software compute the other layers to compensate.

EI-02C202 - Subsurface Drainage Page 1

Drainage – The drainage layer within a design structure can be optional depending on the situation. If a drainage layer is not required then click the button “Not Required” and the software will bypass the drainage requirements. If the drainage layer is required the click the “Required” button and the software will go to a second screen that has the button for “Compute Drainage Layer”. *See*

UFC 3-260-02 App “E” Ref
Determination of Flex Strength

Appendix D – Computing a Drainage Layer

Flexural Strength – Enter the flexural strength of the new concrete to be placed. Procedures for determining the flex strength of the PCC can be found in appendix E of UFC 3-260-02.

UFC 3-260-02 Ref
Load Transfer Described Page 12-1

% Joint Load Transfer – For design, a load transfer value of 25 percent is routinely used as a reasonable approximation of the load transfer measured over time on the types of joints approved for use in Army and Air Force airfields. The actual load transfer at a joint will vary depending on joint type, quality of construction, slab length, number of load repetitions, temperature conditions, etc. The design charts in this chapter were developed based on a 25 percent load transfer value. If adequate load transfer is not provided at the joints of trafficked slabs, the pavement should be designed for no load transfer using the PCASE pavement design program that allows direct input of the load transfer value or the gross load used in the design charts in this chapter should be increased by 1/3 to remove the load transfer effect.

UFC 3-260-02 Ref
Typical PR for pavement materials Page 11-7

Modulus – modulus of elasticity of concrete, usually taken as 27,575 MPa (4 × 106 psi)

Poisson's Ratio – Enter the Poisson's Ratio of the concrete material.

EI-02C202 - Subsurface Drainage Page 1

Thickness – Usually required as drainage layer or separation layer inputs. This value can be calculated or entered manually. This field will also be required if the user selects to set the thickness of the asphalt or base course manually.

Creating Season Sets for Layered Elastic Designs

One of the most powerful features of Layered Elastic Criteria is the ability to provide a different set of modulus values for different seasons of the year. This gives the user the ability to model their design based on real world conditions that are ever changing depending on the time of year. Looking at Figure 2-8, one the user has built the initial design using the Flexible or Rigid model, they can now click the "Edit Seasons" button to build a custom season set.

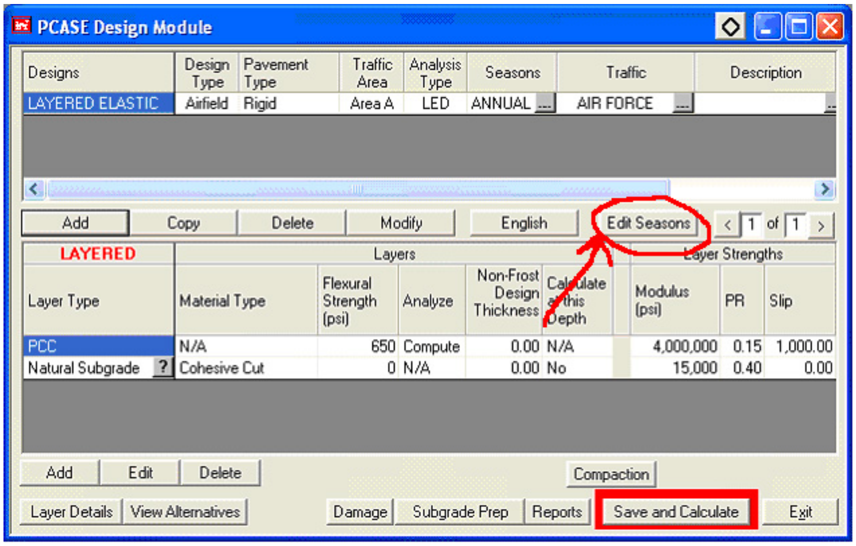


Figure 2-8

Once the “Edit Seasons” button is clicked the screen in figure 2-9 appears. Click the “Add” button to build a new season set. The next screen to open is seen in figure 2-10 asking for the season set name. This screen allows the user to break the year up into various seasons. They can then assign modulus values to the seasons.

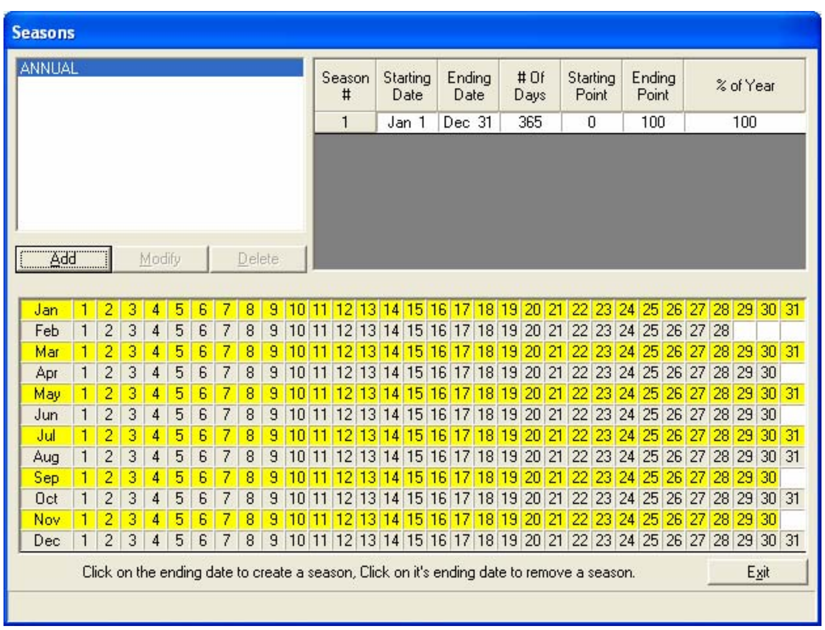


Figure 2-9

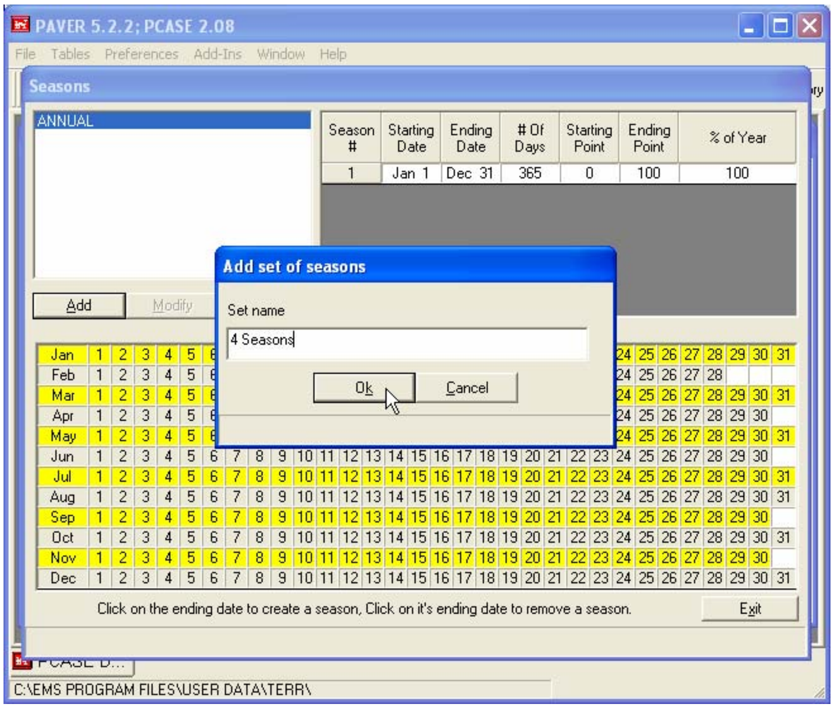


Figure 2-10

To create a season set like you might have in Table 2-1, the easiest way to create the seasons is to click on the END DATE of each season. In Figure2-11 the red boxes are the boxes that were clicked on using the mouse. The LED season editor “wraps” from the end of the year back to the beginning to complete the first season.

Table 2-1

Season #	Start Date	End Date
1	Nov 1st	Feb 28th
2	Mar 1st	May 31st
3	Jun 1st	Aug 15th
4	Aug 16th	Oct 31st

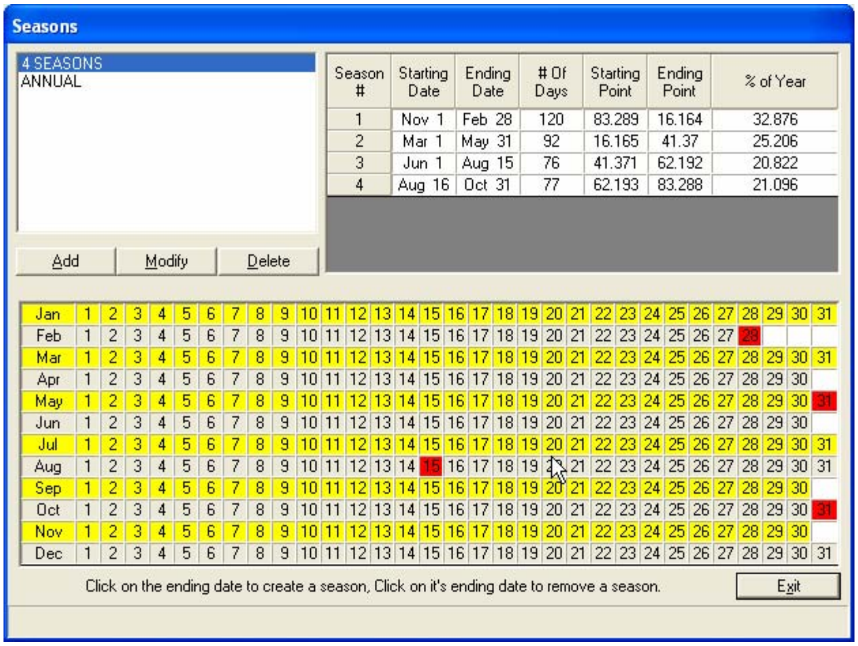


Figure 2-11

Once the user has completed building a season set, click “Exit” to return to the design screen. The next step is for the user to actually assign the newly created season set to their design. As seen in figure 2-12, the user can now click the “…” or “dot-dot-dot” button in the “Seasons” column of the design grid.

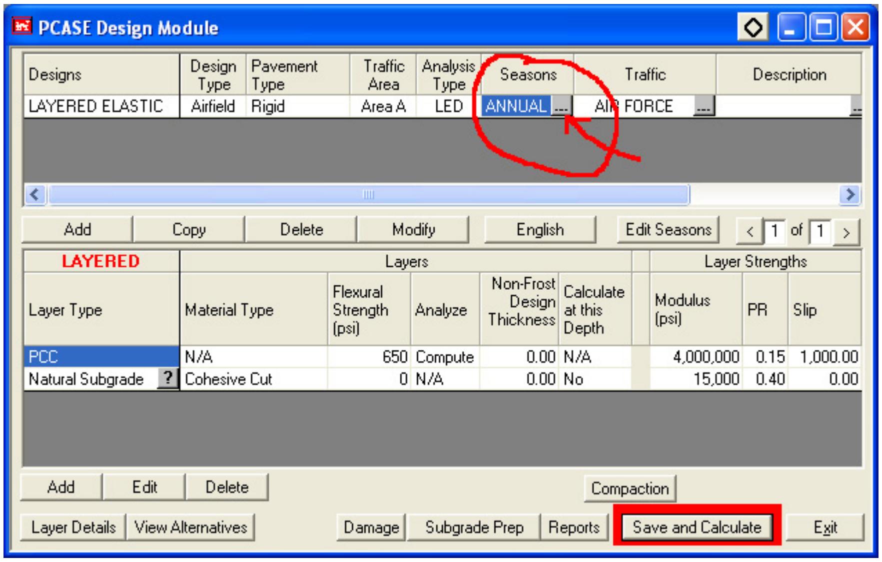


Figure 2-12

Clicking this button then launches the “Season Set” selection box as seen in Figure 2-13. Select the season set you created and click “Ok”.

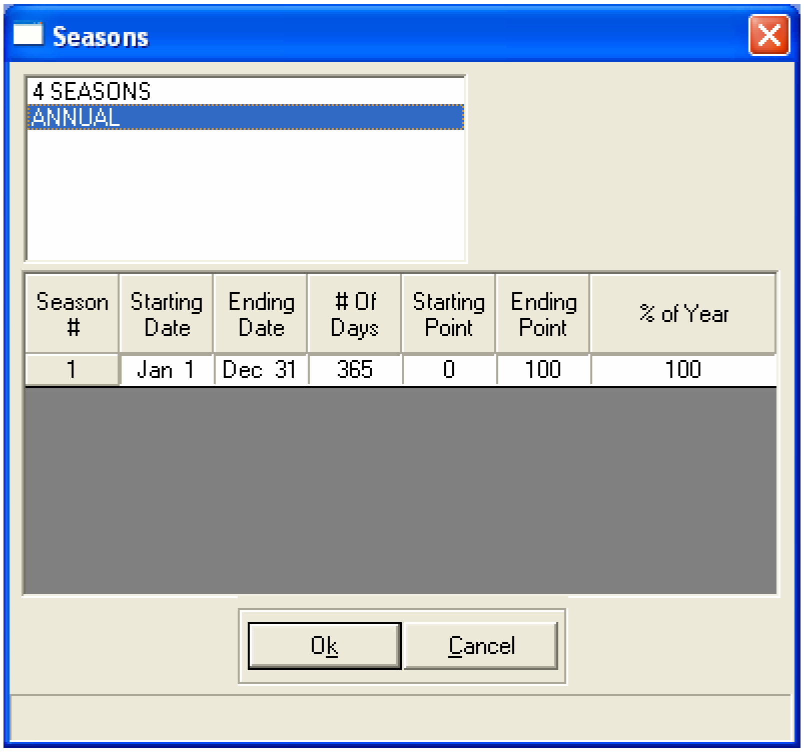


Figure 2-13

Finally, now that proper season set has been selected the software returns the user to the design screen once more. There is one more step remaining to complete the use of seasons. In our previous example we built a season set that had 4 seasons. Because we have 4 seasons, 4 sets of modulus values must be entered for the design example. See Figure 2-14 and notice that because our season set has four seasons, the software now has “1 of 4” above the layer strength values.

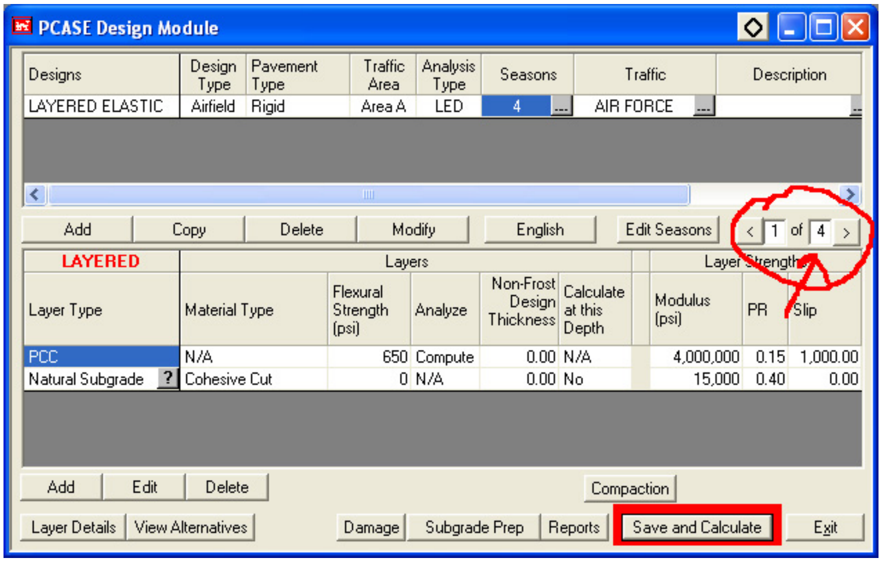


Figure 2-14

Enter the modulus values for each season by typing the modulus values in the modulus column for the first season, then click on the right “>” arrow next to the “4” (for this example, your example may have a different number of seasons) to go to the next season and then enter the modulus values for that season and so forth.

After all seasons of modulus values have been entered click “Save and Calculate”

UFC 3-260-02 Ref
“Seasonal Frost Conditions”
Page 20-1

Performing a Frost Design

Step One - Calculating a “Depth of Frost”

Two variables must be true in order to warrant a frost design. First there must be a “depth of frost”, in other words the seasonal data for the region must get cold enough to penetrate the pavement structure. Secondly, one or more layers within the pavement structure must be “Frost Susceptible”. In other words, in none of the materials used within the pavement are even susceptible to frost then variable one doesn’t matter.

The first step in performing a frost design is to calculate a “Depth of Frost” the steps for calculating a depth of frost can be located in “Appendix F” Depth of Frost Calculation. Once the user has completed their depth of frost calculation they can return here to proceed to the next step.

UFC 3-260-02 Ref “Frost Codes for Materials” Page 20-2

Step Two – Assign Frost Codes To Layers

Once the user has calculated the depth of frost a new column appears in the layer grid for the current design. The column is called “Frost Code”. This allows the user to assign a frost code to each layer. If no layers within the pavement structure are frost susceptible then a frost design is not necessary. To assign frost codes to a layer see Figure 2-15.

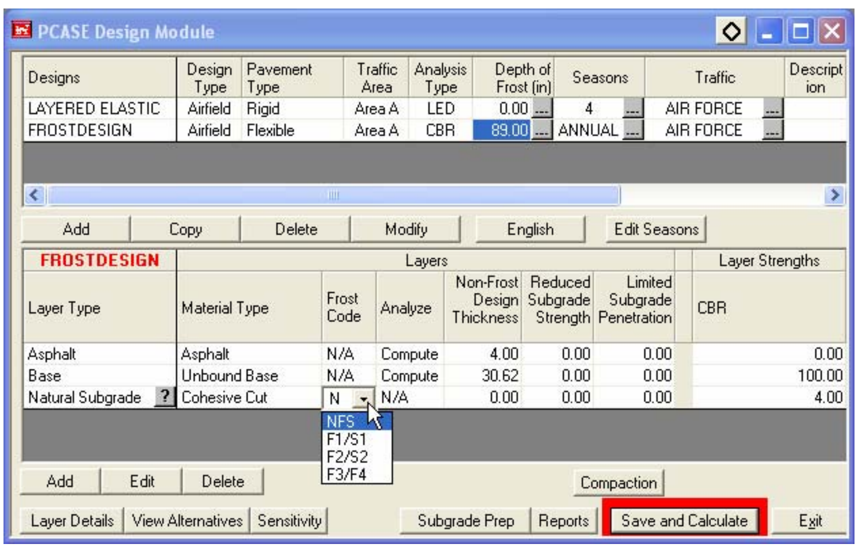


Figure 2.15

Once the frost codes have been entered, the user can click “Save and Calculate” to finish the frost design calculations.

Adding Additional Layers

Once the initial design has been built using the step by step layer builder, the user will see a screen similar to the design in figure 2-16. (This example did NOT include a drainage layer). But the user may want to add additional layers (i.e., a subbase or compacted subgrade) or change layer types (i.e., use a stabilized base course instead of a regular base course). To do this the user can now click the “Add” button that is highlighted in Figure 2-16. This will give the user the option to add layers to their existing layer structure.

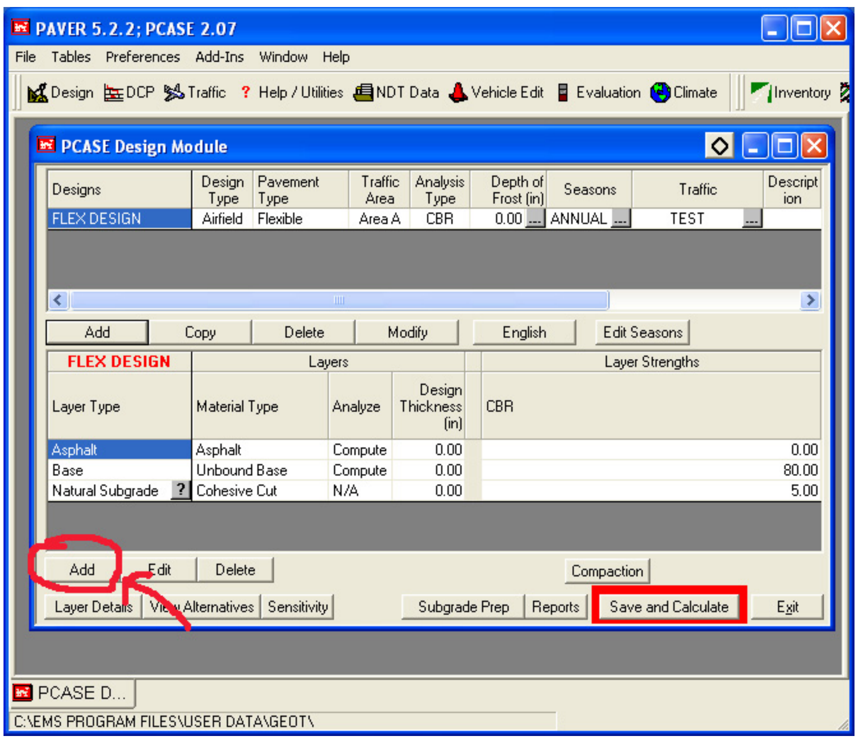


Figure 2-16

Modifying or Copying a Design

After creating a design it may be modified several different ways. The basic design selections may be modified by selecting “Modify” from the row of buttons in the lower middle of the main form. Basically, the user may change from an airfield design to a road design or vice-versa. However, the pavement type and analysis type cannot be changed. The reason for this is each pavement and analysis type have specific rules for the layers permitted. Also the user may click the "Copy" button to make an exact copy of the selected design. This copy may then be modified thus allowing side-by-side comparison of similar designs.

Modifying Layers

Layer data may be changed in several ways. Choosing "Add" from the lower set of buttons presents a list of layer types the user may add to the design. The layer types available depends on the pavement and analysis type of the design. Data for a specific layer may be changed directly on the main form by typing the new value in the grid or selecting from a drop-down list as appropriate. Alternatively, the user may select a layer and then click the "Edit" button and change the values on the form for that layer type. The final method is to select layer details and change the values in the layer detail form. The layer details form provides access to values changed less frequently. Once a design has been calculated, the layer details form provides additional information about the resulting design

Other Screen Options

Layer Details - Clicking the "Layer Details" button in the lower left corner of the main form displays the Layer Details form. Additional layer information of possible interest to the user is displayed. The actual information contained is dependent upon the design method and surface type. Data such as dry weight and density may be entered here for use in frost calculations. Where applicable minimum thickness, equivalent thickness, required thickness and design thickness are displayed for each layer.

Viewing Alternative Designs - After creating and then computing multiple designs, the user may want to see a side-by-side comparison of the various design solutions. Clicking the "View Alternatives" button will display the designs in a picture format. By scrolling vertically and/or horizontally, the user can compare the designs drawn to scale. Moving the mouse across the various layers will display the layer thickness and material type at the bottom of the form.

Sensitivity Curves - For flexible CBR designs and rigid K designs, sensitivity curves are available. Clicking the “Sensitivity” button on the lower half of the main form will display the sensitivity form. Figure 16, “Sensitivity Form” shows a curve based on varying the flexural strength of the Portland-Cement Concrete (PCC) layer. As the mouse moves along the curve the relationship between the flexural strength and PCC thickness is displayed at the bottom of the form. This allows the user to quickly view the change in design thickness caused by increasing or decreasing the flexural strength. By choosing from the available list the user can view the effects of a variety of factors. Please note, the curves plotted are specific to the selected design not the pavement and analysis type in general.

English / Metric – This button gives the user the option of displaying the design either as SI(Metric) or U.S. Customary units(English).

Chapter 3 – Pavement Evaluation Using CBR Values (Empirical / APE Criteria)

UFC 3-250-03 Ref "Airfield Pavement Evaluation"

Create a Traffic Pattern First

All pavement evaluations are based on a planned set of traffic. Before beginning a pavement evaluation, the user must first build a traffic pattern. See appendix "A" in this manual to build a traffic pattern. Then continue with the next step, "Starting the Evaluation Module" below.

UFC 3-260-03 Ref
Determine Design Traffic
Page 4-6

Starting the Evaluation Tool

Now that the user has created a traffic pattern, they are ready to open the evaluation module to do a pavement evaluation. If the user looks in the toolbar, they will see a button labeled "Evaluation" as in Figure 3-1. Click this button to open the evaluation module.

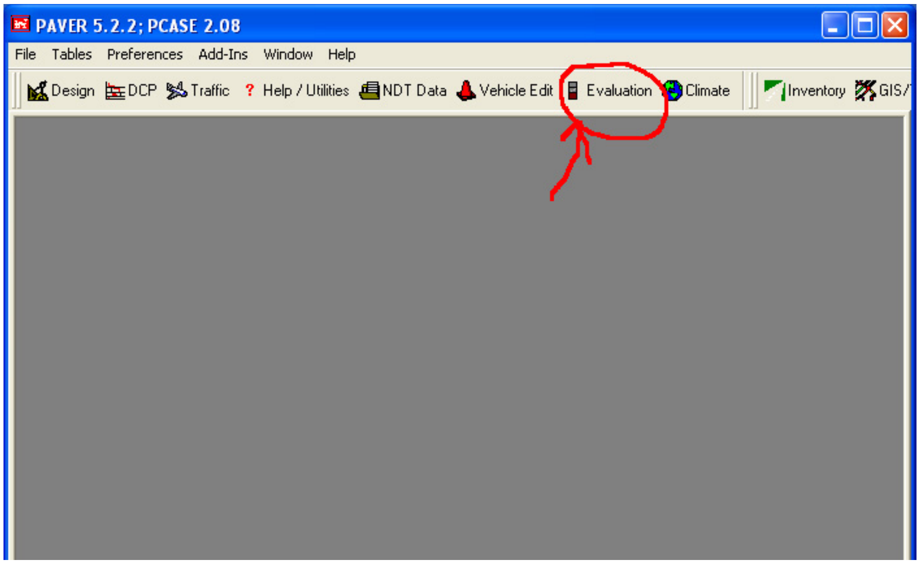


Figure 3-1

Once the user has pressed the "Evaluation" button the following screen appears.

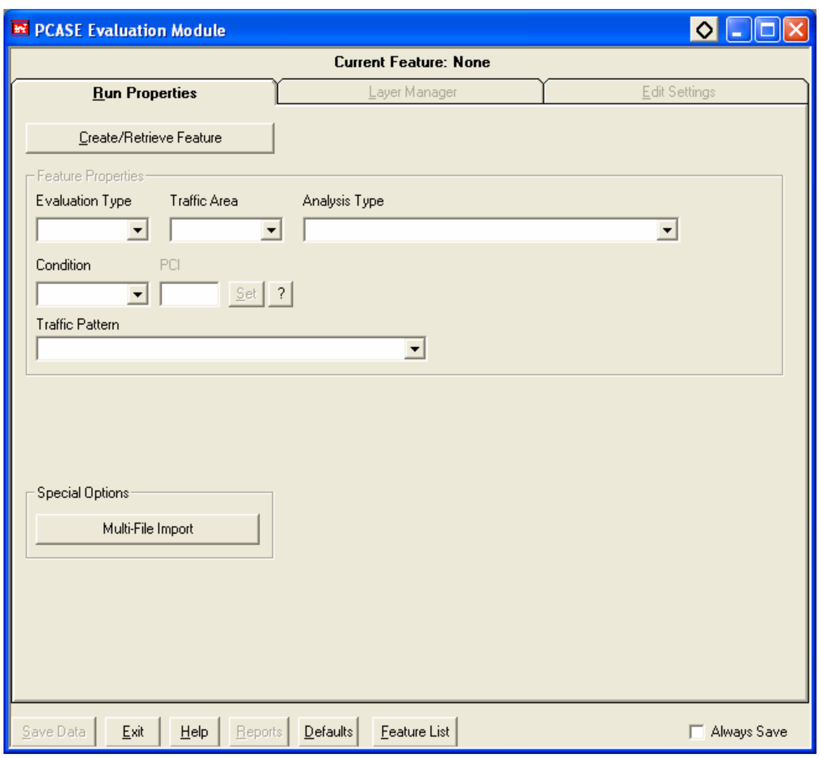


Figure 3-2

First Step – Create Retrieve Feature

UFC 3-260-03 Ref
Feature Identification Page 4-1

ETL 02-19 Ref "Airfield Pavement Evaluation Standards and Procedures"

Before beginning a pavement evaluation, it is important to divide the airfield pavement system into features based upon common characteristics: the pavement type, thickness, surface condition, and construction history data; available subsurface layer data; pavement use; and traffic type. An analysis is then performed on each individual feature, with the lowest rated feature being the controlling value that is reported. The details on breaking up an airfield into features can be located in ETL 02-19 "Airfield Pavement Evaluation Standards and Procedures"

The PCASE evaluation module manages these features using a screen called "Select Inventory". This process gives the user a mechanism for breaking up the pavement into multiple manageable pieces. To start an evaluation click the button called "Create/Retrieve Feature". The screen seen in figure 3-3 appears.

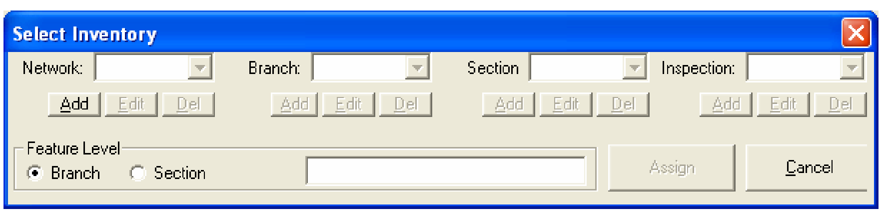


Figure 3-3

For example, figure 3-4 displays a typical airfield layout broken up into "features". To best model this airfield layout in the software, the user can add inventory one of two ways, represented in tables 1 and 2.

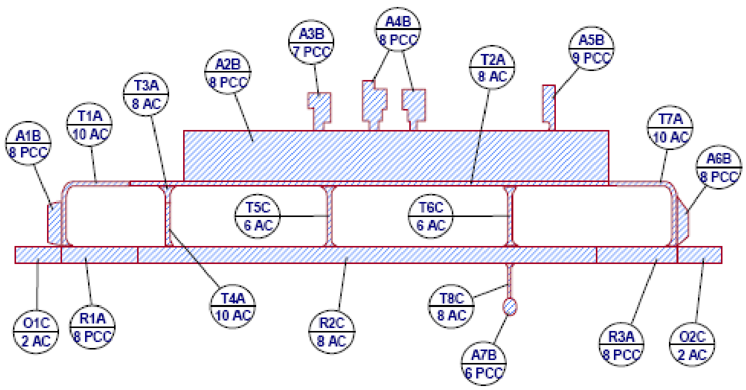


Figure 3-4

Network	Branch	Section	Inspection
Polk AAF	A1B	01	07/04/2004
	T1A	01	07/04/2004
	T3A	01	07/04/2004
	A2B	01	07/04/2004
	A3B	01	07/04/2004

Table 1 - Features created at the Branch level

Network	Branch	Section	Inspection
Polk AAF	NW Aprons	A3B	07/04/2004
		A4B	07/04/2004
	Runway 90	R1A	07/04/2004
		R2C	07/04/2004
		R3A	07/04/2004

Table 2 - Features created at the Section level.

The first step is to add a “Network”. Typically there is only one network per “PVR” project file. So click the “Add” button beneath the Network and type in your network name. In the example in the tables above the network name was “Polk AAF”.

Next, assuming the user will be organizing their inventory like Table 2, click the “Add” button beneath the Branch and type in “NW Aprons” as the Branch name and A3B as the section name. The resulting screen will look like figure 3-5.

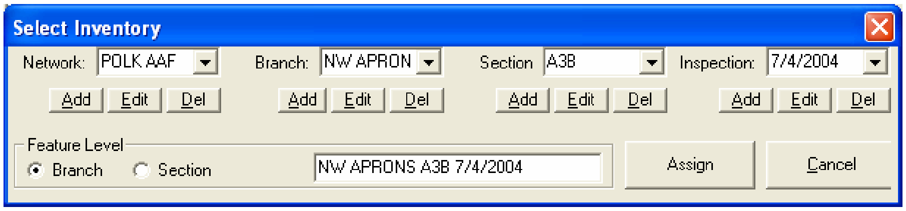


Figure 3-5

Once the feature has been added, the user can click the "Assign" button to enter the evaluation module and perform the pavement evaluation analysis for the current feature. After clicking the "Assign" button a form like Figure 3-4 appears. Notice at the top of the form the current feature is identified as "NW Aprons A3B 7/4/2004". This indicates that all the data about to be entered on the form is only for that feature. To switch to a different feature and perform a new analysis the user would once again click on the "Create/Retrieve Feature" button and select a new feature to analyze.

The "Run Properties" Screen

Now that a feature has been created enter the data for that feature on the "Run Properties" screen. See figure 3-6

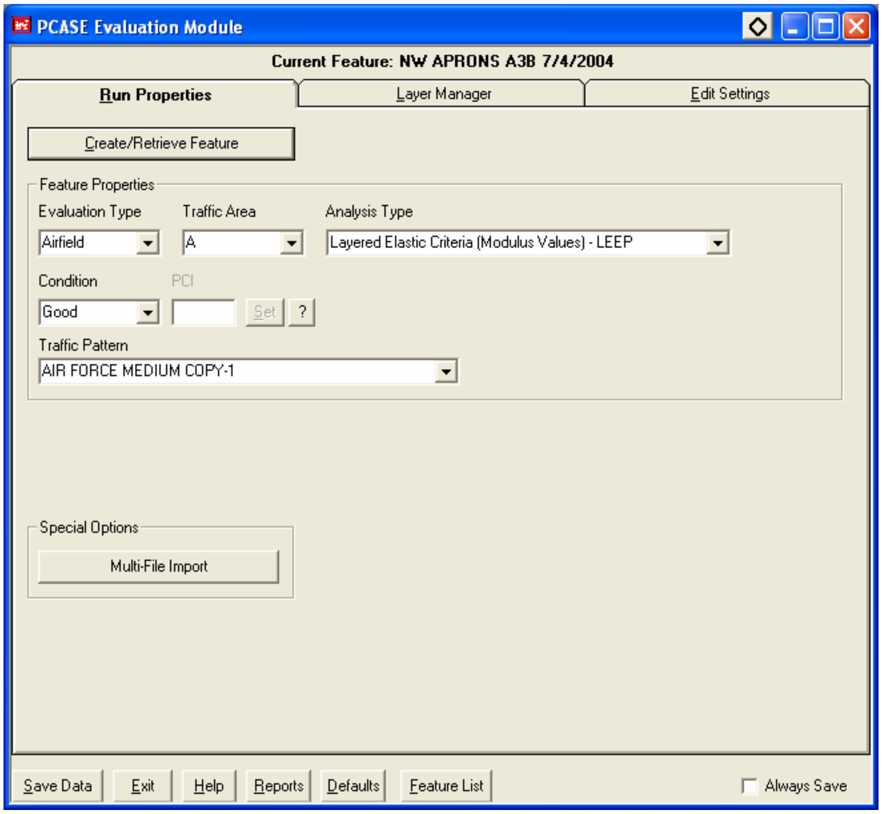


Figure 3-6

Evaluation Type – The options are "Airfield" or "Road". Set this parameter to the appropriate pavement type.

Traffic Area - Air Force airfield pavements are categorized by traffic area as a function of traffic distribution and aircraft weight. The Air Force defines traffic areas in four categories (types A, B, C, and D) as described in TI 825-01/AFM 32-1124(I)/NAVFAC DM 21.10. The Army defines traffic areas in three categories (types A, B, and C). The Navy and Marine Corps define traffic areas as primary and secondary. For evaluation purposes, the Navy and Marine Corps also use the Army defined A, B, and C traffic areas. "A" is used for channelization traffic typically found on aprons. The terms "primary" and "secondary" refer to the pavement rank which is assigned as part of the condition survey. A primary pavement could have either "A" or "B" traffic depending on its use. Location of traffic areas depends on the airfield class or type as defined in TI 825-01/AFM 32-

UFC 3-260-03 Ref
Traffic Area ID Page 401

1124(I)/NAVFAC DM 21.10, for the Army and Air Force and in MIL-HDBK-1021/2 for the Navy and Marine Corps.

Analysis Type – The PCASE evaluation module gives the user a choice in which criteria can be used to calculate the allowable loads and passes for the pavement. The first choice is to use CBR or empirical criteria, and secondly to use the layered elastic criteria. (See Chapter 4 for Pavement Evaluation Using Layered Elastic Criteria)

UFC 3-260-03 Ref
Poor Condition Pavements
Page 6-3

Pavement Condition – The user options are “Good”, “Fair” and “Poor”. If the user selects “Poor”, then a note appears that says “Load Reduction in Effect”. This triggers the software to take the calculated Allowable Gross Load (AGL) and automatically reduce it by 25%. If the user selects “Good” or “Fair”, then the AGL is left alone. More information on this reduction can be found on pages 6-2 and 6-3 in the UFC 3-260-03 “Airfield Pavement Evaluation”.

Traffic Pattern – Select the appropriate traffic pattern for this evaluation. See Appendix “T” for more on building traffic patterns.

Once these options are filled the user can go to the “Layer Properties” screen to continue the evaluation process. Here is a description of the remaining screen items.

Always Save – This option allows the user to always save their data and the computer will not ask again.

Multi-File Import – This button will allow the user to create a set of features based on a set of “FWD” or “HWD” data files. CBR evaluations ignore this button.

Save Data – Save the data for this feature to the database.

Exit – Exit the evaluation module.

Help – Open the help file.

Reports – Open the evaluation report module. This will allow the user to create a feature level report for a variety of data sets.

Defaults – This option allows the user to set defaults for various options in the evaluation module. For example, by default the evaluation module uses the layered elastic criteria. If the user always uses the CBR criteria then they can change it in the "Defaults" and from now on their PCASE software will default to the CBR criteria.

Feature List – This option displays all the features for the users' project in a tree view.

The "Layer Properties" screen allows the user to create the layer structure for their evaluation.

Building Layers using the "Layer Properties" Screen

Using DCP Layers

If the user has previously entered DCP Data, see "Appendix E – Using the DCP Module" then the software will notify the user that they have DCP data for their feature. See figure 3-7. As soon as the user clicks the "Use DCP Layers" button their layers are imported into the layer grid of the Evaluation module.

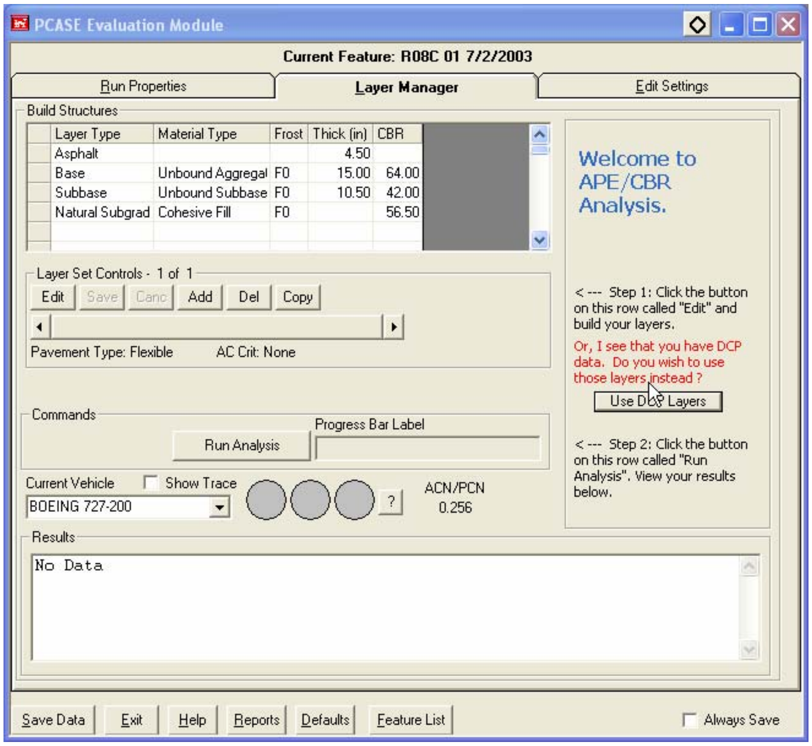


Figure 3-7

Building Layers Manually in the Evaluation Module

The “Layer Properties” screen for CBR analysis allows the user to create the layer structure for their evaluation using CBR values. Looking at the right side of the screen of figure 3-8, a CBR analysis can be performed in two steps. First, create the layer structure, and second click “Run Analysis”.

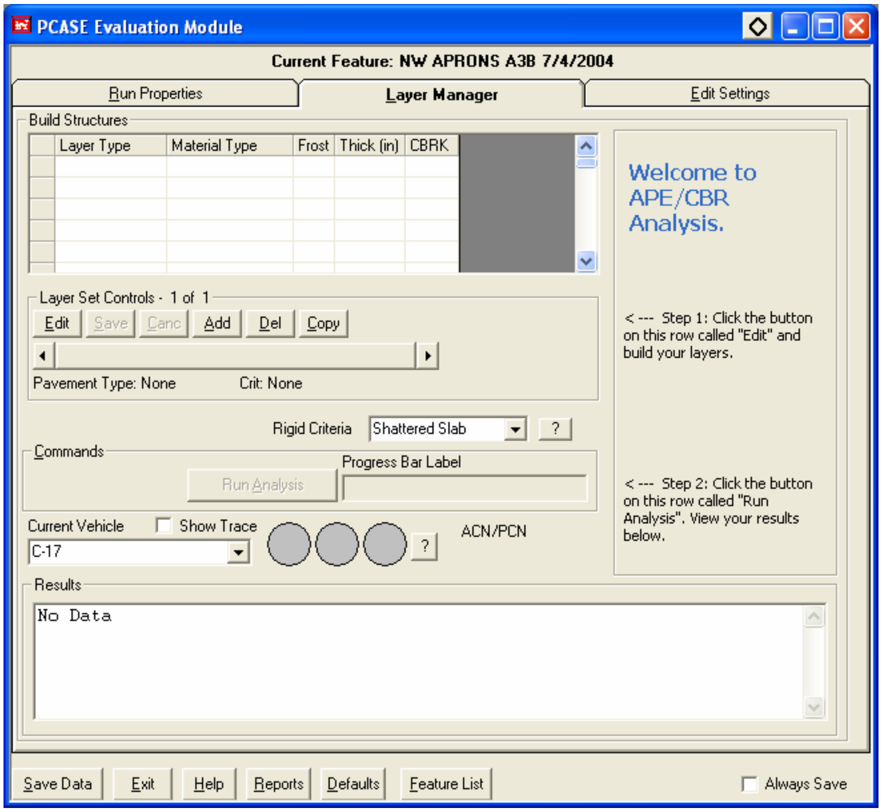
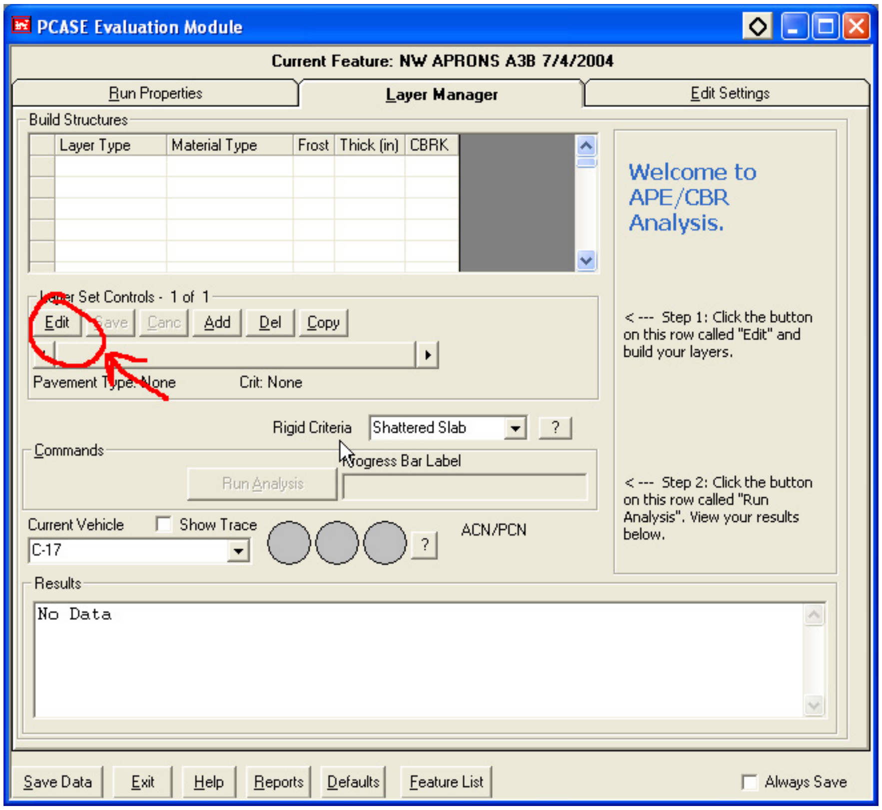


Figure 3-8

Building a Layer Structure

UFC 3-260-03 Ref
Page 5-7 "Equivalency Factors"

To build the layer structure, click the "Edit" button underneath the layer grid. See figure 3-9. This puts the grid into edit mode and the user can click inside the "Layer Type" cell and click the arrow to select the layer type for each layer in the existing layer structure.



UFC 3-260-03 Ref
Page 7-6 Frost Codes for material types.

Figure 3-9

The user can build their layer structure one layer at a time by selecting the layers from the top down in the grid. See figure 3-10.

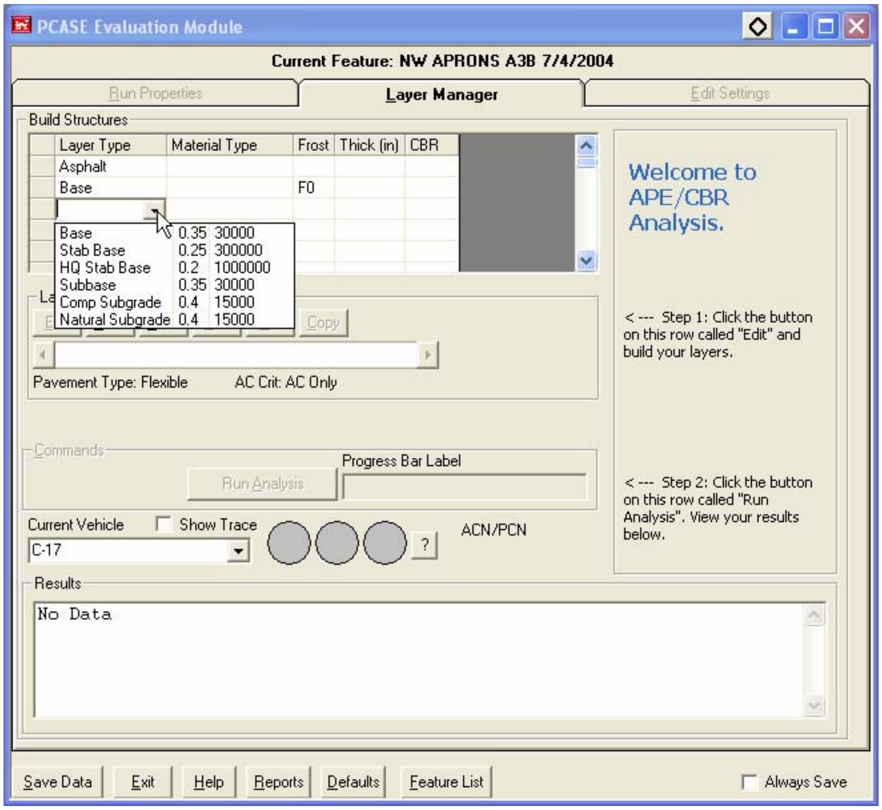


Figure 3-10

Material Type – The user must select a “Material Type” for each layer (except the surface layer). This is solely for selecting what equivalency factors will be used in the evaluation. The two numbers beside the material type indicate what the equivalency factors for that material type for “Base” and “Subbase” are, respectively. For example, in figure 3-11, if the “Unbound Crushed Stone” material type is used for the Base then every inch of base greater than the minimum required will be multiplied by “2” when determining “Equivalent Subbase”. All equivalency factors used by the Army, Navy, Marine Corps, and Air Force are shown in paragraph titled “Evaluations for Stabilized Layers” located on pages 5-7 and 5-8 of UFC 3-260-03 “Airfield Pavement Evaluation”

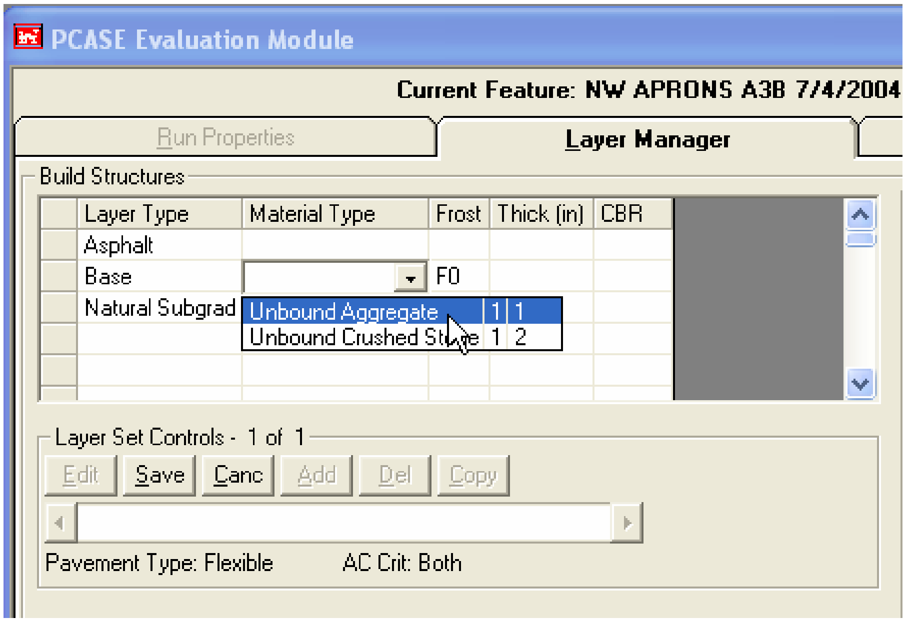


Figure 3-11

Frost Code – If the user is performing a pavement evaluation for frost conditions, they should first calculate a "Depth of Frost" using Appendix F of this manual. Then they can assign frost codes to any layer that is defined as frost susceptible material.

Thick – Enter the thickness of the layer.

CBR – Enter the CBR value for the layer.

Finally after the user has completed building the layer structure (See Figure 3-12) click the "Save" button located under the layer building grid.

Running the Pavement Analysis

The user can now click the "Run Analysis" button to complete the evaluation. See figure 3-13. See Appendix "R" Evaluation Results Grid for a detailed explanation on reading the Results grid.

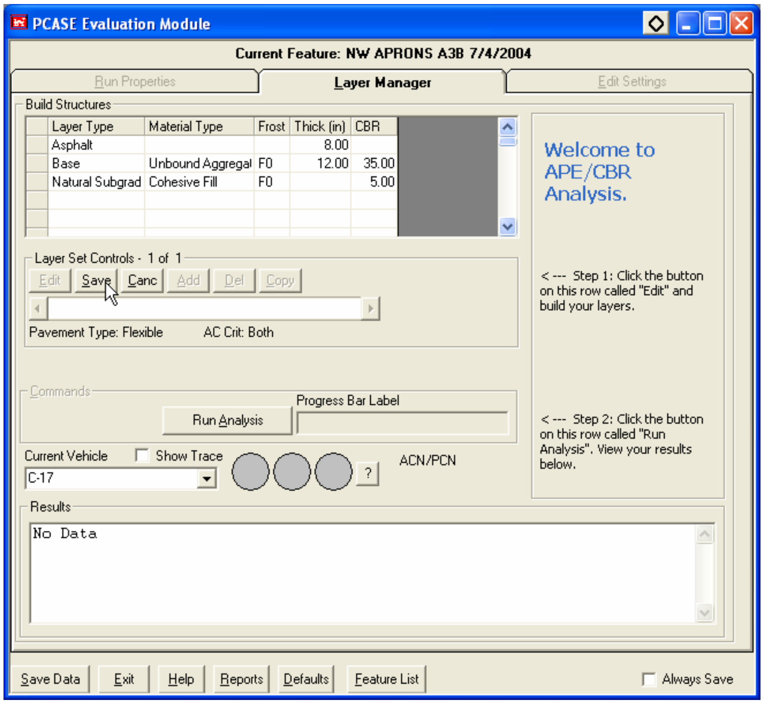


Figure 3-12

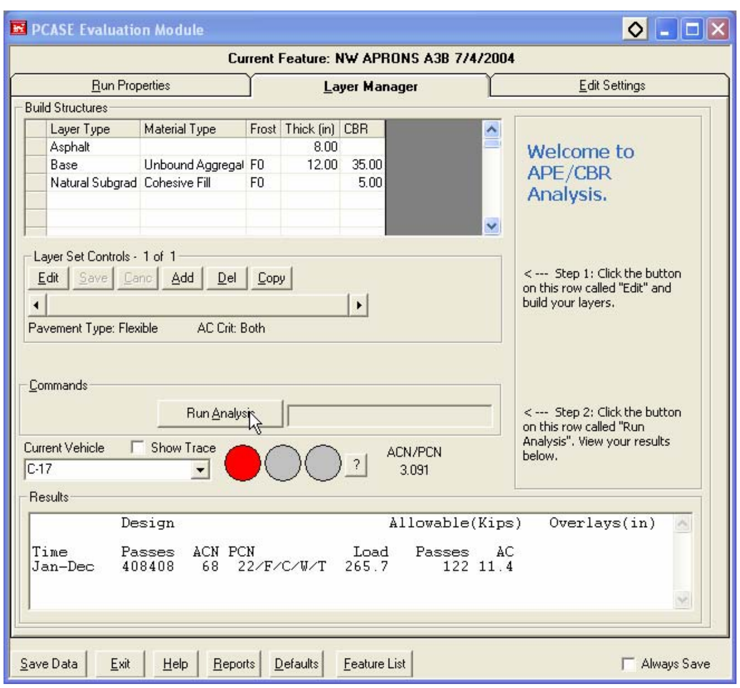


Figure 3-13

Chapter 4 – Pavement Evaluation Using Modulus Values (Layered Elastic Criteria)

Create a Traffic Pattern First

All pavement evaluations are based on a planned set of traffic. Before beginning a pavement evaluation, the user must first build a traffic pattern. See appendix “T” in this manual to build a traffic pattern.

Appendix D – Drainage Layer Calculation

Using the Drainage Layer Module

EI-02C202 - Subsurface Drainage Ref

When the user selects “Compute Drainage Layer” the following screen will come appear (See Figure D-1). To navigate through the screen the user will press the “Tab” key to go to the next cell. The worksheet will update the calculations only after the user proceeds to the next cell. So after the last input is entered, press the “Tab” key one more time to update the final calculations at the bottom. See the input descriptions below.

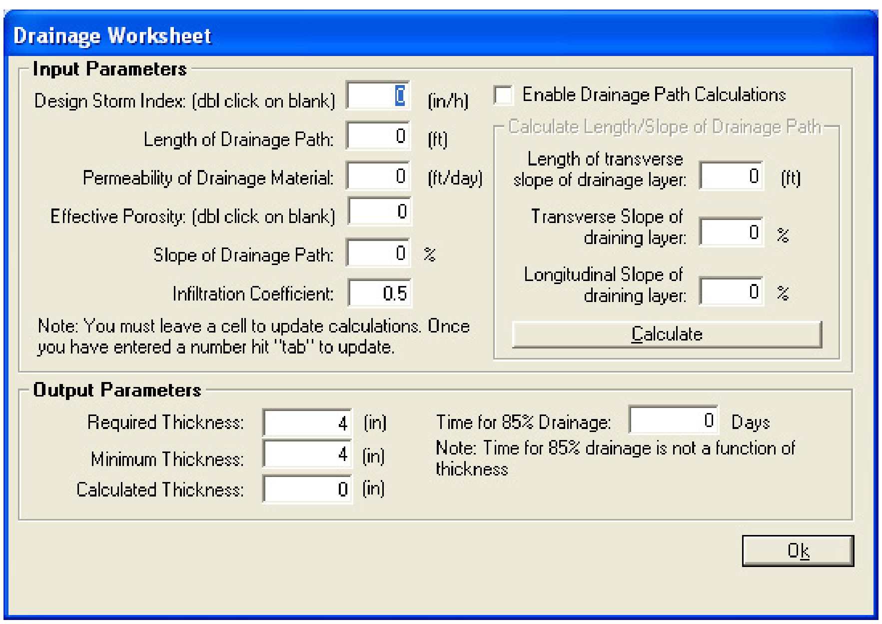


Figure D-1 - Opening Screen for Drainage Layer Calculation

EI-02C202 – Page 33
“Design Storm Index”

Design Storm Index – Double click inside of this box to open the Precipitation database. (See Figure D-2) This will allow the user to select the design storm index for a given local.

Length of Drainage Path – This is the total distance that a rain drop will travel. This value can be entered or it can be calculated using the "Enable Drainage Path Calculations" check box.

Length of Transverse Slope of Drainage Layer – (See Figure D-3 "Transverse Length")This is the horizontal distance from the crown of the pavement structure to the edge.

EI-02C202 Ref
Length and Slope of drainage path Page 37

Transverse Slope of Drainage Layer – (See Figure D-3 "Transverse Slope") This is the slope of the pavement from the crown to the edge of the pavement.

Longitudinal Slope of Drainage Layer – (See Figure D-3 "* Longitudinal Slope")This is the slope of the pavement along the length of the runway.

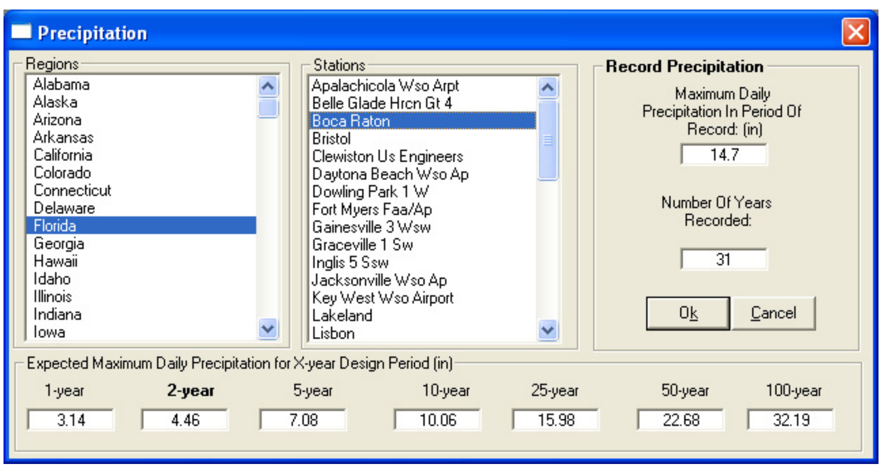


Figure D-2 - Design Storm Index Screen

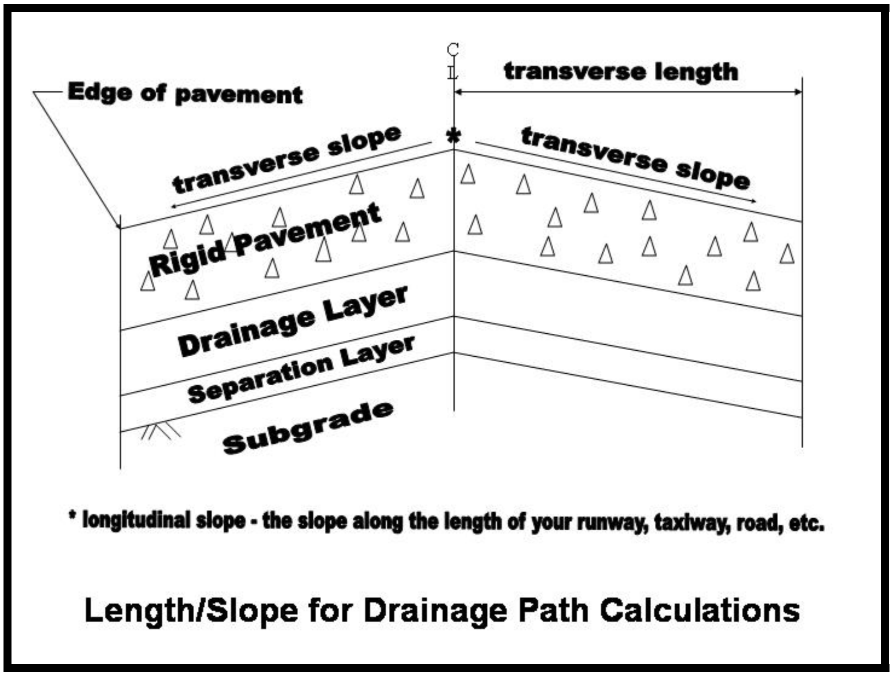


Figure D-3 - Pavement Structure Showing the Input Values Required for Drainage Layer Calculations

EI-02C202 Ref
Flow of Water through soils
Page 13

Permeability of Drainage Material – A measure of the rate at which water passes through a unit area of material in a given amount of time under a unit hydraulic gradient.

EI-02C202 Ref
Effective Porosity Defined
Page 16

Effective Porosity – The effective porosity is defined as the ratio of the volume of voids that will drain under the influence of gravity to the total volume of a unit of aggregate. The difference between the porosity and the effective porosity is the amount of water that will be held by the aggregate. For materials such as the RDM and OGM, the water held by the aggregate will be small; thus, the difference between the porosity and effective porosity will be small (less than 10 percent). The effective porosity may be estimated by computing the porosity from the unit dry weight of the aggregate and the specific gravity of the solids which then should be reduced by 5 percent to allow for water retention on the aggregate. The user can “Double-Click” on the blank to get some typical values for effective porosity of materials.

Slope of Drainage Path – This is the slope of the raindrop path taking into account both the transverse and longitudinal slope of the pavement structure. This value can be entered or calculated using the "Enable Drainage Path Calculations" checkbox.

Infiltration Coefficient – Ratio of infiltration to rainfall. The infiltration coefficient will vary over the life of the pavement depending on the type of pavement, surface drainage, pavement maintenance, and structural condition of the pavement. Since the determination of a precise value of the infiltration coefficient for a particular pavement is very difficult, a value of 0.5 may be assumed for design.

EI-02C202 Ref
Infiltration Defined Page 10

Required Thickness – This is the final results calculated by the drainage layer algorithms.

Minimum Thickness – The minimum value of thickness that the drainage layer must be.

Time for 85% Drainage – The amount of time that it will take to move 85% of the water from the pavement. The criteria states that this time must be less than 1 day. If it is not then some of the inputs will need to be adjusted to make 85% of the water drain from the pavement in less than 1 day.

EI-02C202 Ref
85% Rule Page 20

Appendix E – Using the Dynamic Cone Penetrometer (DCP) Module

What is the DCP Module?

The DCP or "Dynamic Cone Penetrometer" module is a software tool that works in conjunction with a DCP device for using blows and penetration to determine layer CBR strength values.

Opening the DCP Module

To open the DCP module select the button in the PCASE toolbar as seen in figure E-1.

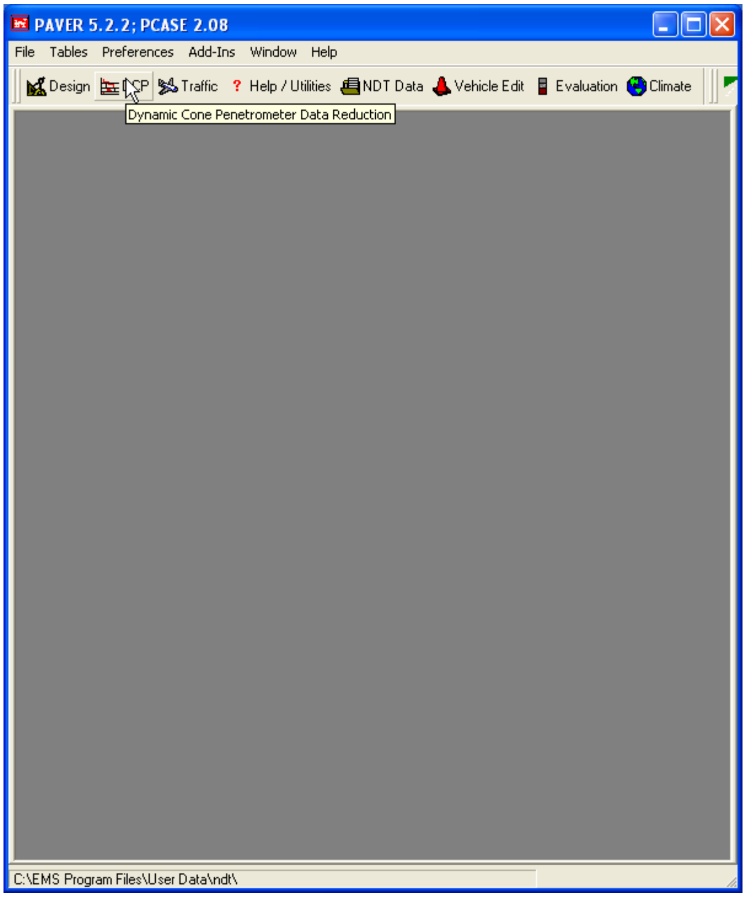


Figure E-1

This will open the DCP module as seen in figure E-2

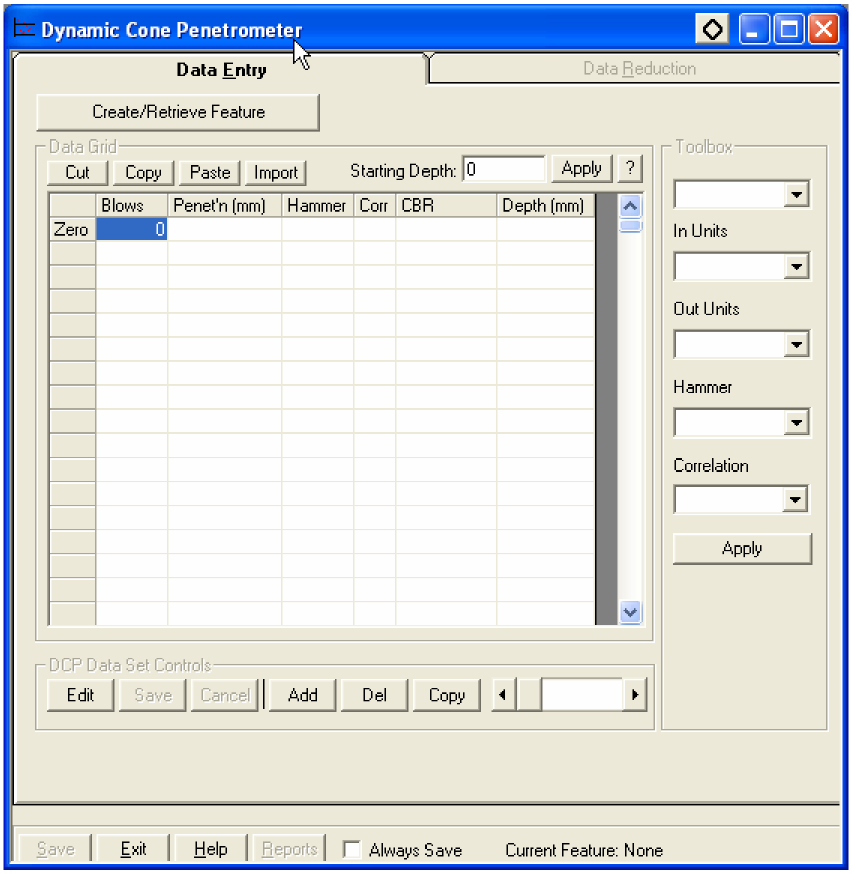


Figure E-2

.

The first step when using DCP is to “Create/Retrieve Feature”. The DCP module must know where this DCP test was taken and what feature to save this data with. For a complete description of “Features” see the section in this manual entitled, “First Step – Create Retrieve Feature” in Chapter 3 – Pavement Evaluation.

DCP Data Toolbox

These flags should be se before the user begins to enter their data into the DCP grid.

CBR / K / Modulus – Three correlations are available for the layer strength. The default is CBR.

In Units – The units used for the penetration column. This is the units used for the measurements.

Out Units – The units for output. Whatever units are selected here will be displayed in the “Depth” column as well as on the DCP plot.

Hammer – The DCP hammer can either be 17.6 lbs or 10.1 pounds depending on the soil strength. Set this “Hammer” flag to whatever weight was used during the test.

Correlation – Generally this is left on “All Soils”. But if the user knows that their data was collected in a “Heavy Clay” or “Lean Clay” then they may switch to a correlation that more closely matches.

Entering DCP Data

To begin entering DCP data click the “Edit” button as seen in figure E-3. This makes the data entry grid now editable.

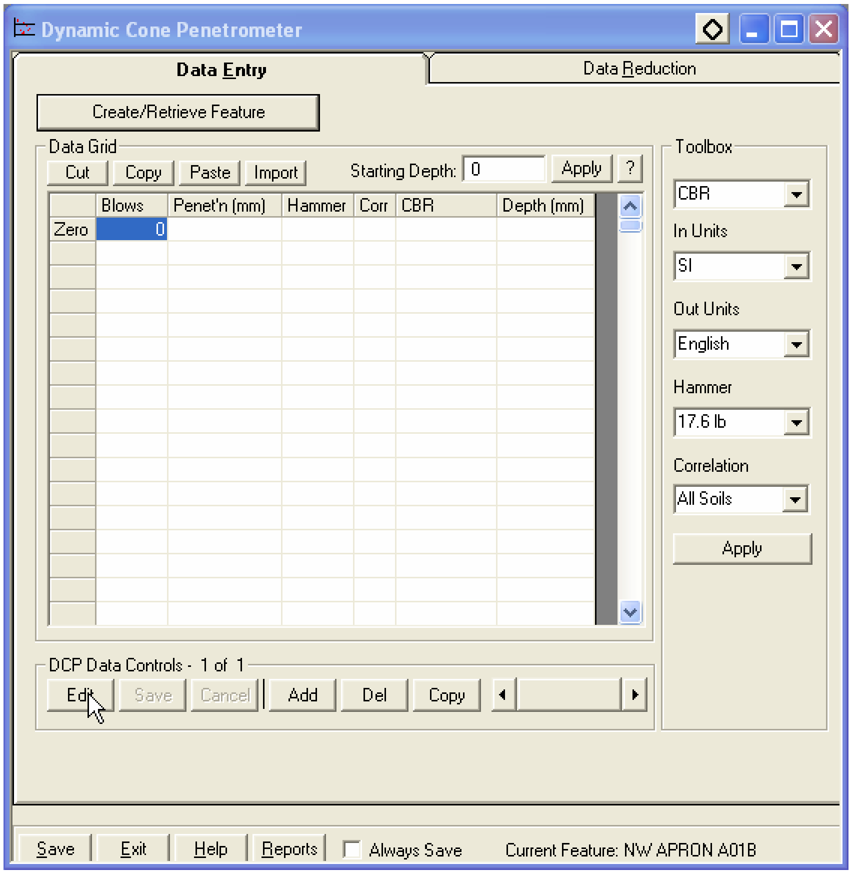


Figure E-3

To build a DCP test the user enters two columns of data, “Blows” and “Penetration”. The other columns are filled in automatically. The hammer and correlation columns automatically set to whatever the hammer and correlation flags are set to in the toolbox on the right side of the screen. Figure E-4 shows a sample DCP grid with some user data being entered.

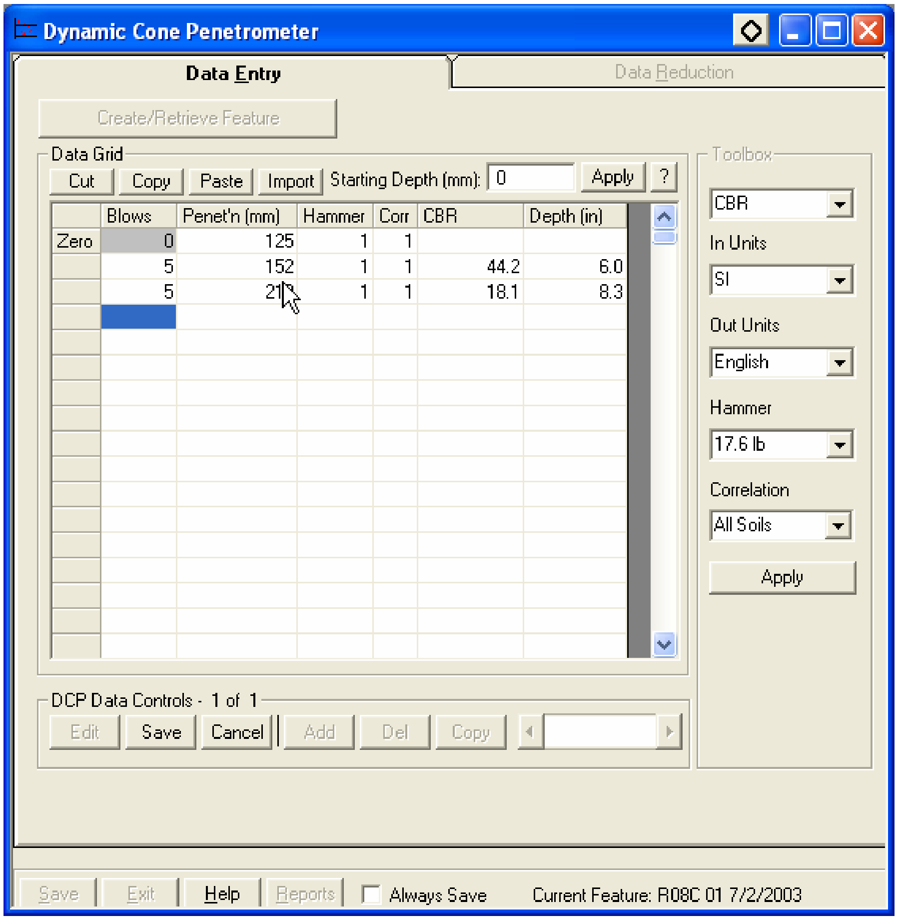
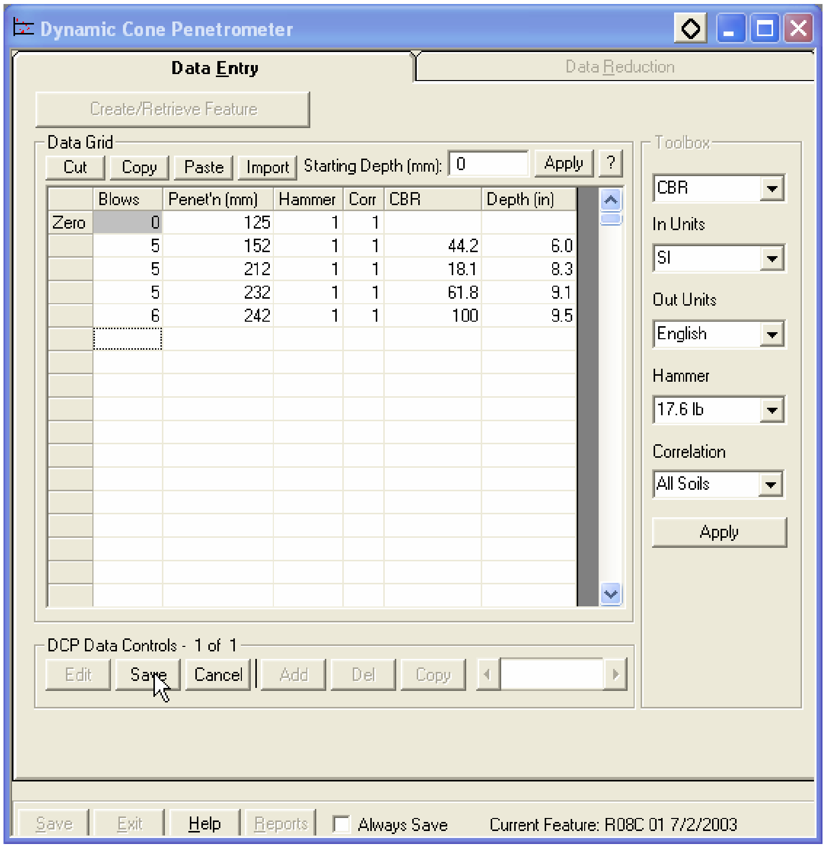


Figure E-4

Once the user completes entering their data they should click the "Save" button right below the grid. See figure E-5.



	Blows	Penet'n (mm)	Hammer	Corr	CBR	Depth (in)
Zero	0	125	1	1		
	5	152	1	1	44.2	6.0
	5	212	1	1	18.1	8.3
	5	232	1	1	61.8	9.1
	6	242	1	1	100	9.5

Figure E-5

Data Reduction Tab

Once the “Save” button has been clicked, the user can click on the “Data Reduction” tab to begin breaking the DCP test into layers. Figure E-6 shows the “Data Reduction” tab with the DCP data plotted in the DCP graph.

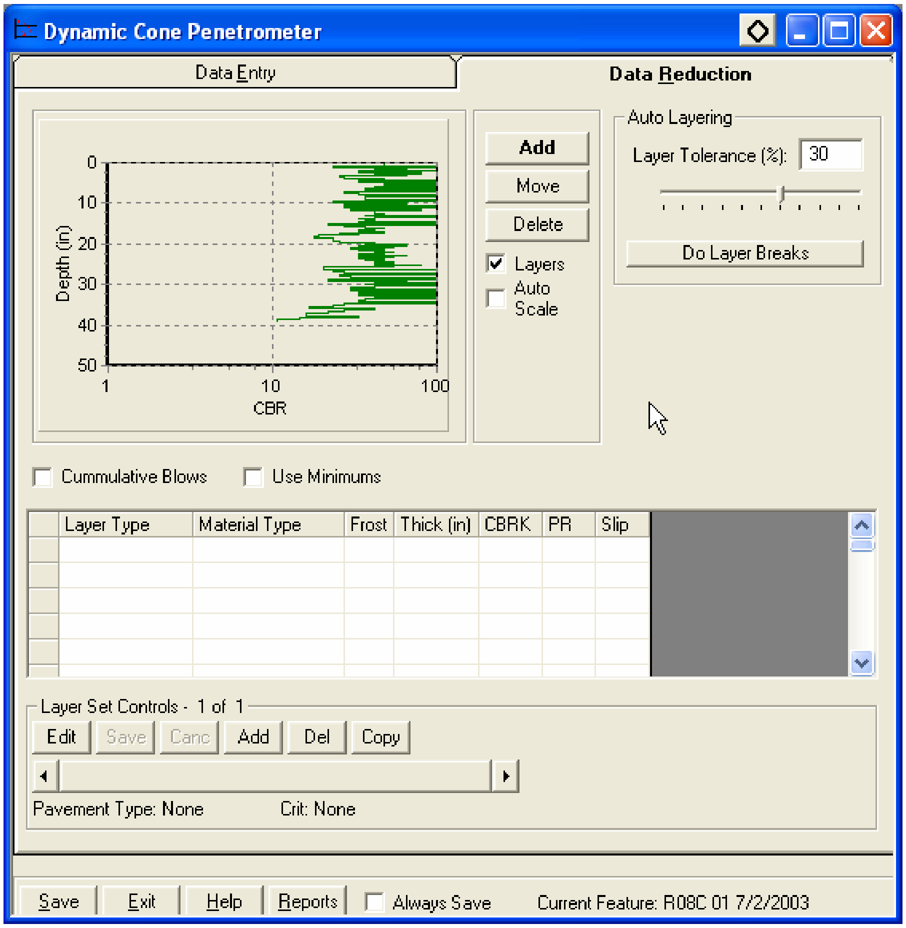


Figure E-6

Building DCP Layers

The object of this screen is to convert the DCP plot into a layer set. There are a few options for making this happen.

Do Layer Breaks – This is an algorithm for "Auto" breaking the DCP plot into layers. It computes a running average of the CBR data and when that average changes to a value greater that the "Layer Tolerance" then the software interprets that as a layer interface.

Manually Building Layers – Use the "Add", "Move", and "Delete" buttons to build the layer structure by hand. When the "Add" button is selected then when the user clicks on the graph, a layer interface will be created wherever the user clicks. When the "Move" button is active, then the user can drag the existing layer interfaces to new positions. See Figure E-7. As the user builds layers by interacting with the plot, the grid automatically displays the user defined layers. The layer types are unassigned, but the thickness column is filled. The thickness in the distance between the blue lines. The CBR/K column is also filled. This is the average of the data between the blue lines.

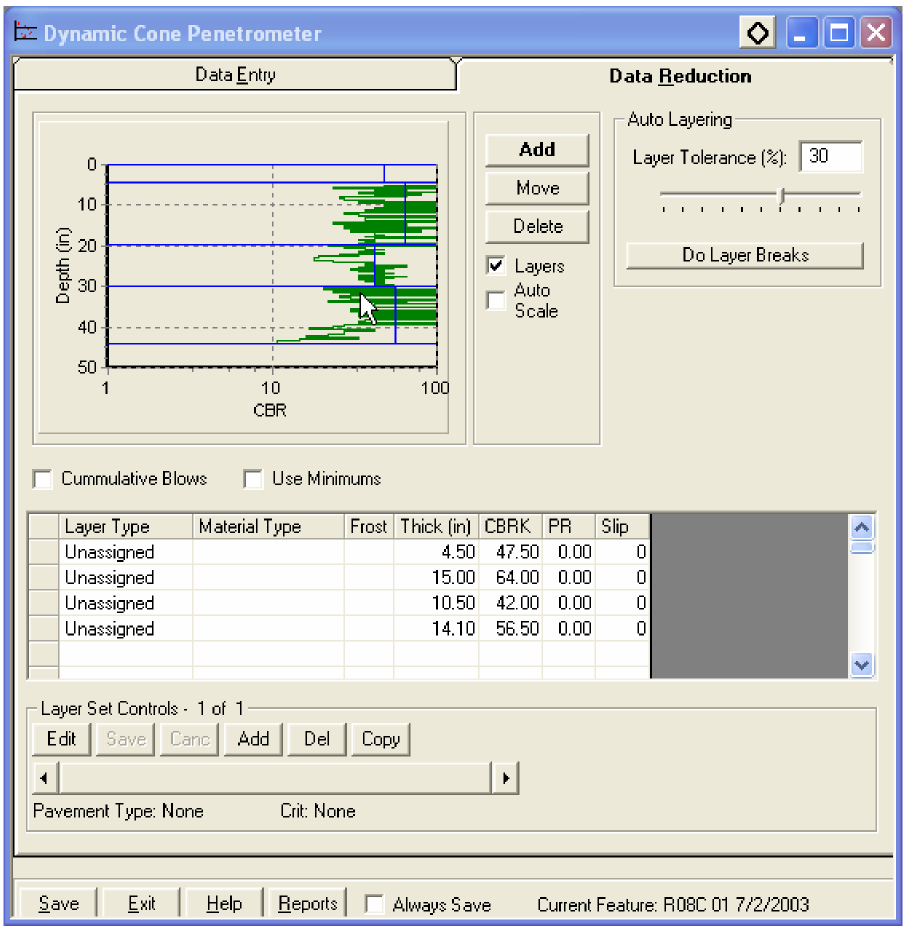


Figure E-7

Finishing the Layer Structure

To finish the layer structure, click the "Edit" button underneath the layer grid. See figure E-8. This puts the grid into edit mode and the user can click inside the “Layer Type” cell and click the arrow next to each “Unassigned” to select the layer type for each layer in the existing layer structure.

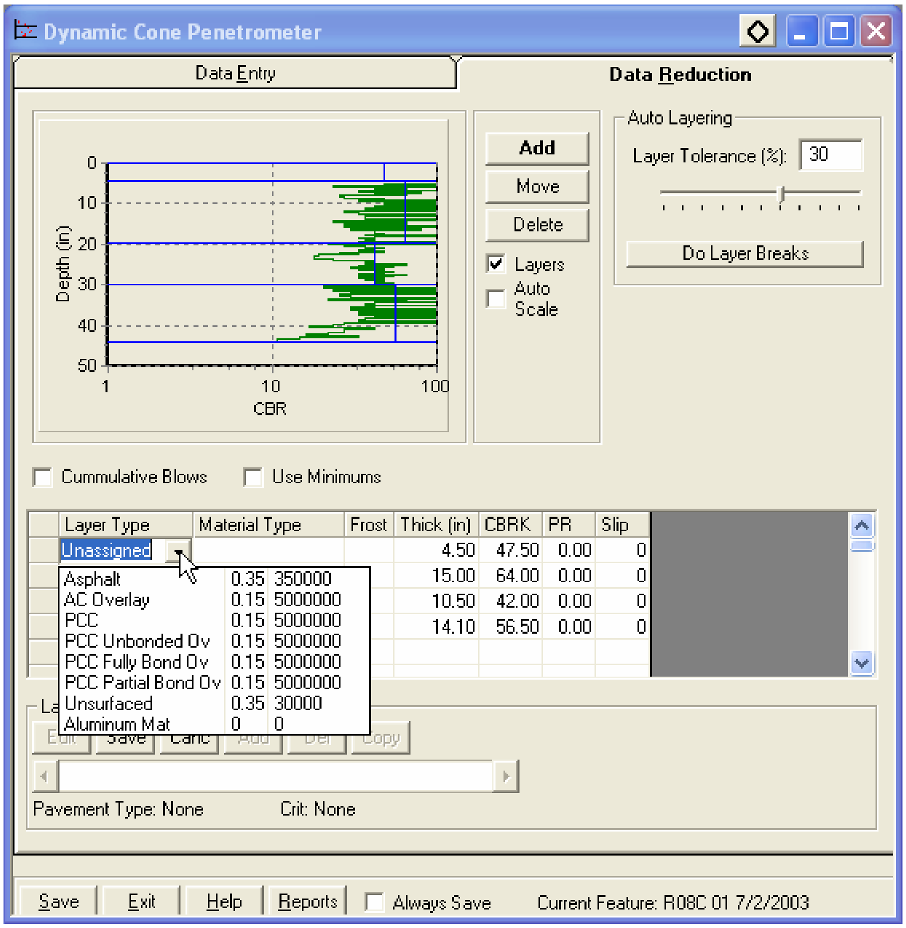


Figure E-8

Material Type – The user must select a “Material Type” for each layer (except the surface layer). This is solely for selecting what equivalency factors will be used in the evaluation. The two numbers beside the material type indicate what the equivalency factors for that material type for “Base” and “Subbase” are, respectively. For example, in figure E-9, if the “Unbound Crushed Stone” material type is used for the Base then every inch of base greater than the minimum required will be multiplied by “2” when determining “Equivalent

Subbase". All equivalency factors used by the Army, Navy, Marine Corps, and Air Force are shown in paragraph titled "Evaluations for Stabilized Layers" located on pages 5-7 and 5-8 of UFC 3-260-03 "Airfield Pavement Evaluation"

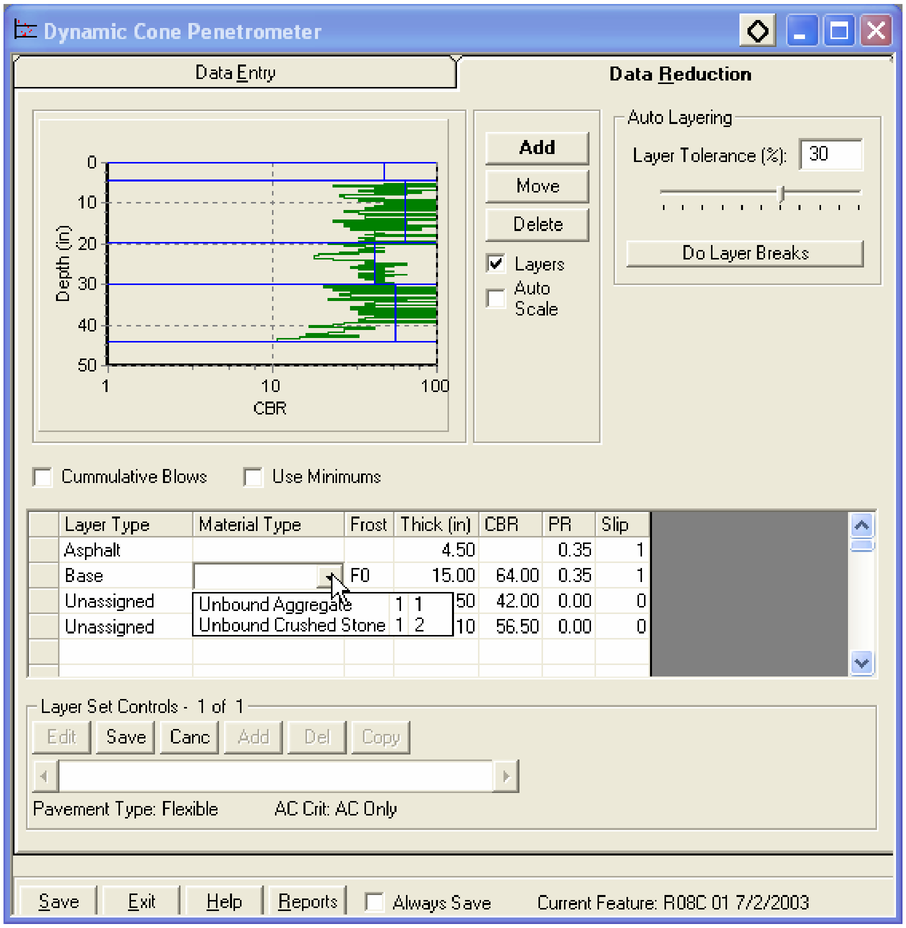


Figure E-9

Frost Code – If the user is performing a pavement evaluation for frost conditions, they should first calculate a "Depth of Frost" using Appendix F of this manual. Then they can assign frost codes to any layer that is defined as frost susceptible material.

Thick – Enter the thickness of the layer.

CBR – Enter the CBR value for the layer.

Finally after the user has completed building the layer structure (See

Figure E-10) click the “Save” button located under the layer building grid.

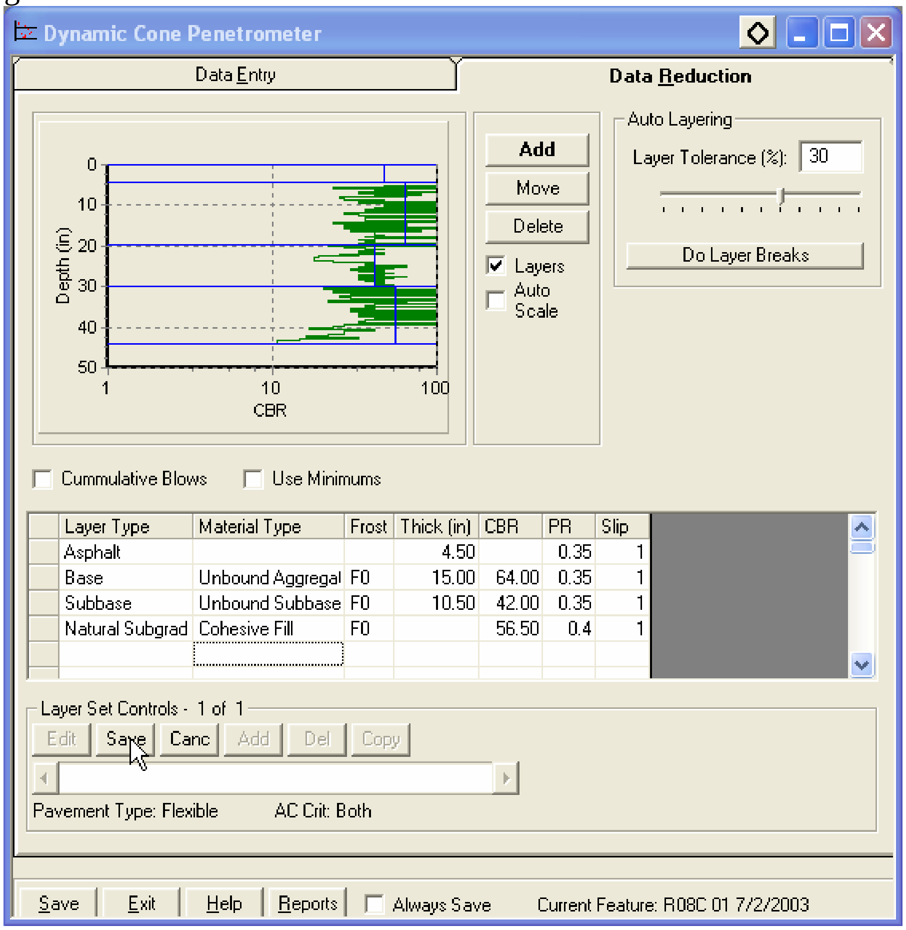


Figure E-10

Appendix F – Depth of Frost Calculation

The Depth of Frost Calculator

UFC 3-260-02 Design for Seasonal Frost Conditions Page 7-3

When building a design or evaluation where seasonal variations need to be considered, the PCASE software has a module for calculating the depth of frost for a given region of the world.

In the design module, the button for opening the depth of frost calculator is located in the top grid in the column "Depth of Frost". To start the module, click the "…" or "dot-dot-dot" button in the depth of frost column on the row of your design. See Figure F-1. ***Note:*** *This button does not appear for layered elastic designs.*

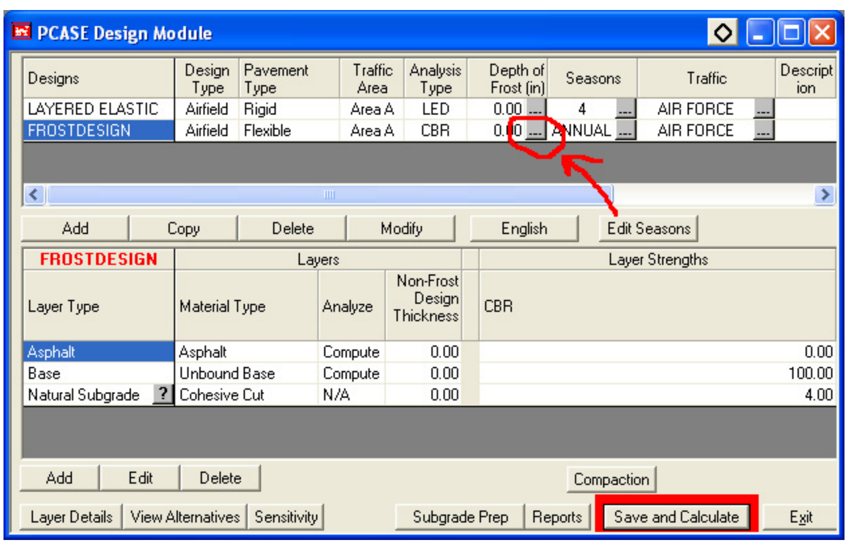


Figure F-1

Figure 4 - Design screen with depth of frost button highlighted.

In the evaluation module, the button for opening the depth of frost calculator is located on the "Edit Settings" tab, then select the "Analysis" option at the top of the form, and then to start the module, click the "…" or "dot-dot-dot" button next to "Depth Frost" in the bottom right corner of the screen. See Figure F-2. ***Note:*** *To activate the button the "Evidence of Frost Damage" checkbox must be selected.*

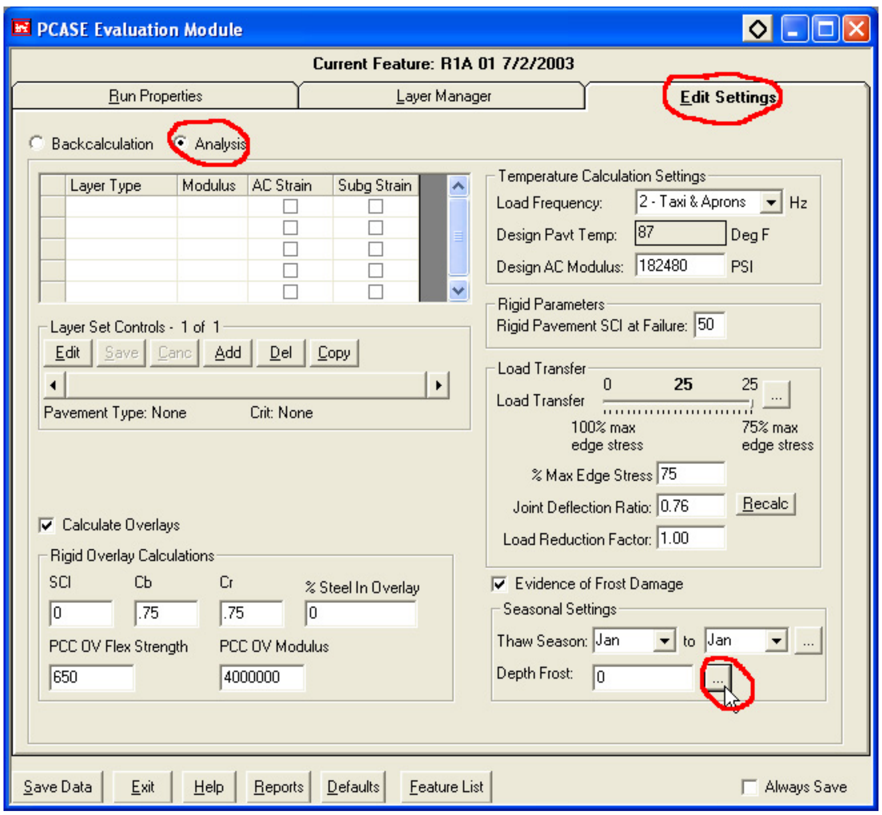


Figure F-2

In order to perform a depth of frost calculation, a standard non-frost design must already have been calculated. This gives the depth of frost routine a set of existing thicknesses to use for the frost thickness determination. One the depth of frost button is clicked a screen like figure F-3 will appear.

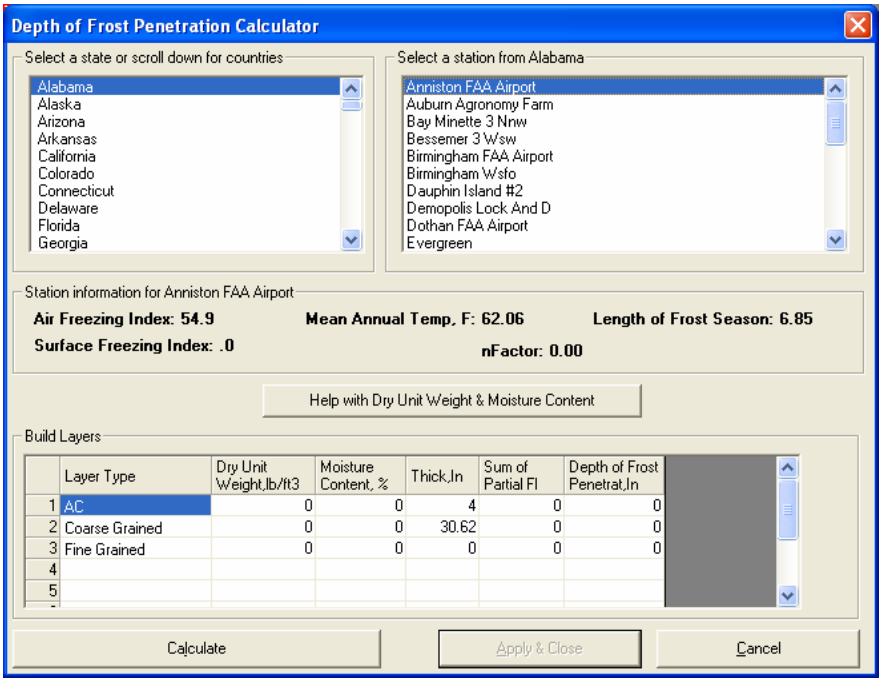


Figure F-3

Select a state or scroll down for countries – Select the state or country that the pavement design or evaluation will be performed. This will populate the right side window with the weather stations located in that state or country.

Select a Station – Select the weather station to use to pull seasonal data from the database. Select a station closest to the area that the pavement design or evaluation will be performed.

Dry Unit Weight – Enter the dry unit weight of the material used for this layer. (See Figure F-4 for common values.)

Moisture Content – Enter the moisture content of the material used for this layer. (See Figure F-4 for common values.)
Calculate – Once the above dry unit weights and moisture contents have been entered click the "Calculate" button to perform the depth of frost calculation.

Apply & Close – This will complete the depth of frost calculation by closing the window and transferring the value to the design or evaluation screen.

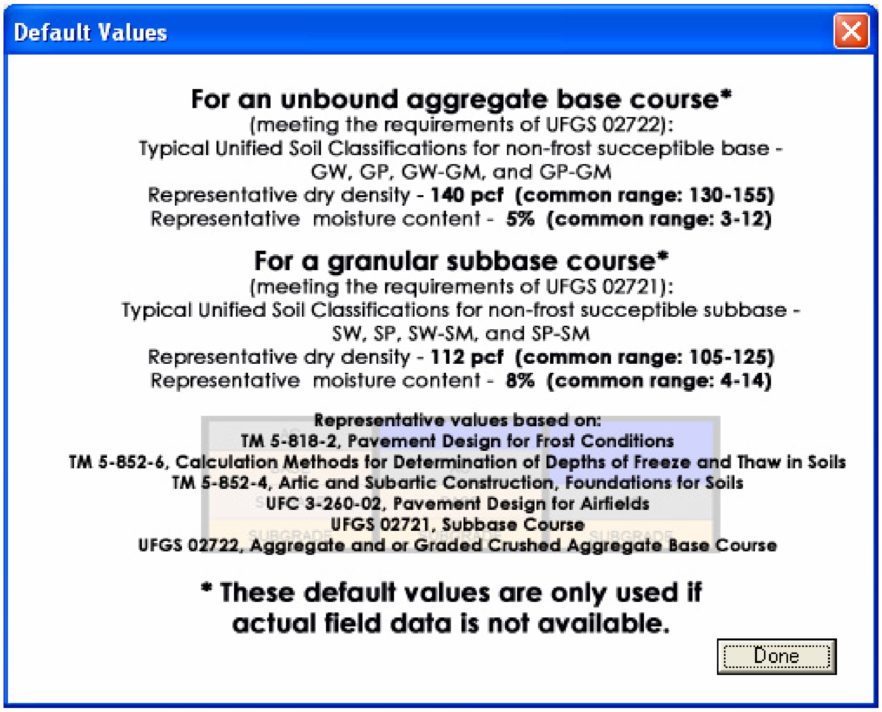


Figure F-4

Appendix N – Using the Non-Destructive Testing (NDT) Module

What is the NDT Module?

The NDT or “Non-Destructive Testing” module is a tool for importing falling weight deflectometer data or FWD data from the Dynatest FWD or HWD and then allowing the user to view the data through various charts. This tool also allows the user to use their falling weight data to define feature boundaries as well as assign the data for backcalculation.

Opening the NDT Module

To open the NDT module select the button in the PCASE toolbar as seen in figure N-1.

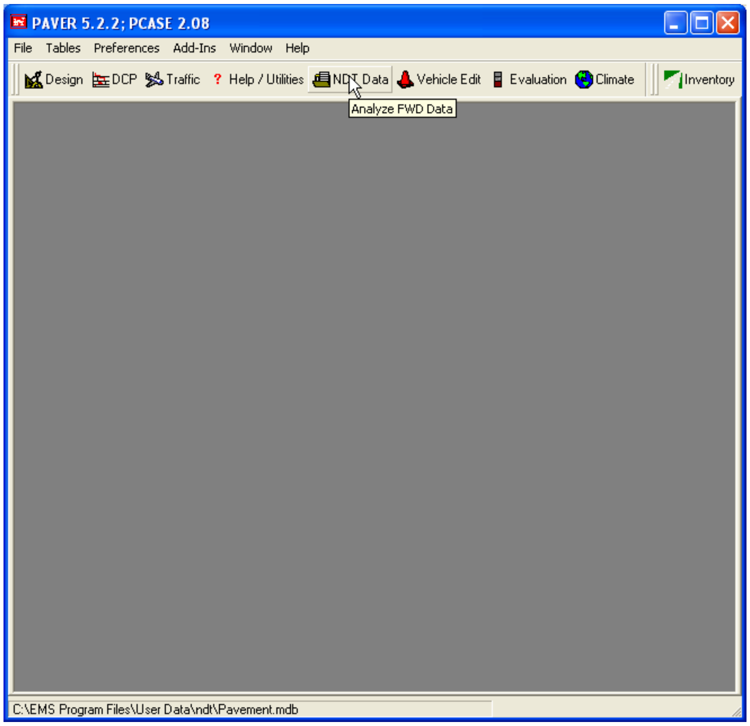


Figure N-1

This will open the NDT module as seen in figure N-2.

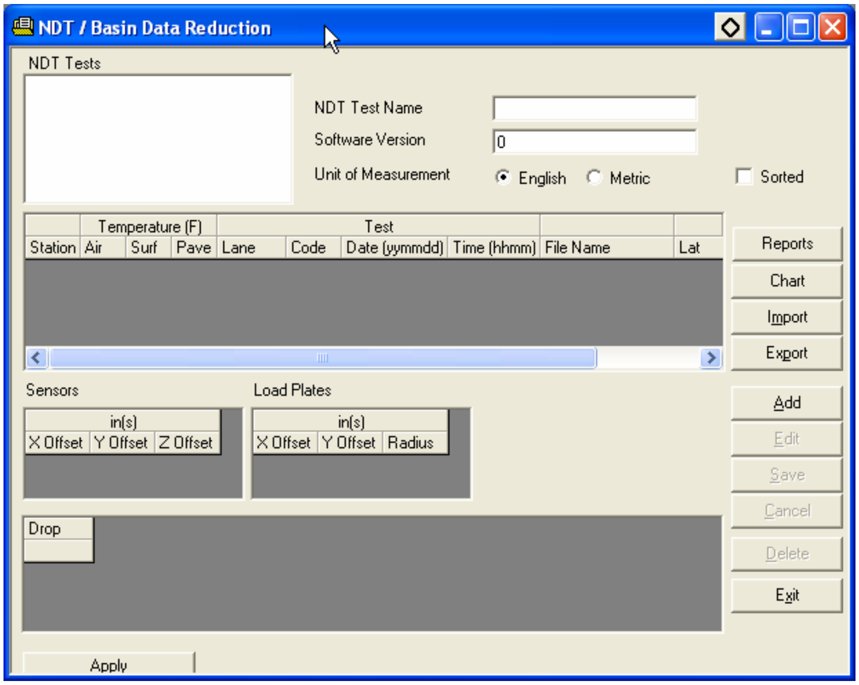


Figure N-2

Importing NDT Data

The first step to using the NDT module is the "Import" button (See Figure N-3. This button allows the user to import the FWD or HWD file created from the falling weight Dynatest software. It currently ONLY imports the ASCII version of the data, not the new MDB file format. Clicking the Import button opens a file dialog as seen in figure N-4. This allows the user to select the FWD files from their test device. The user can import multiple files by using the Windows standard CTRL or SHIFT keys when selecting multiple files.

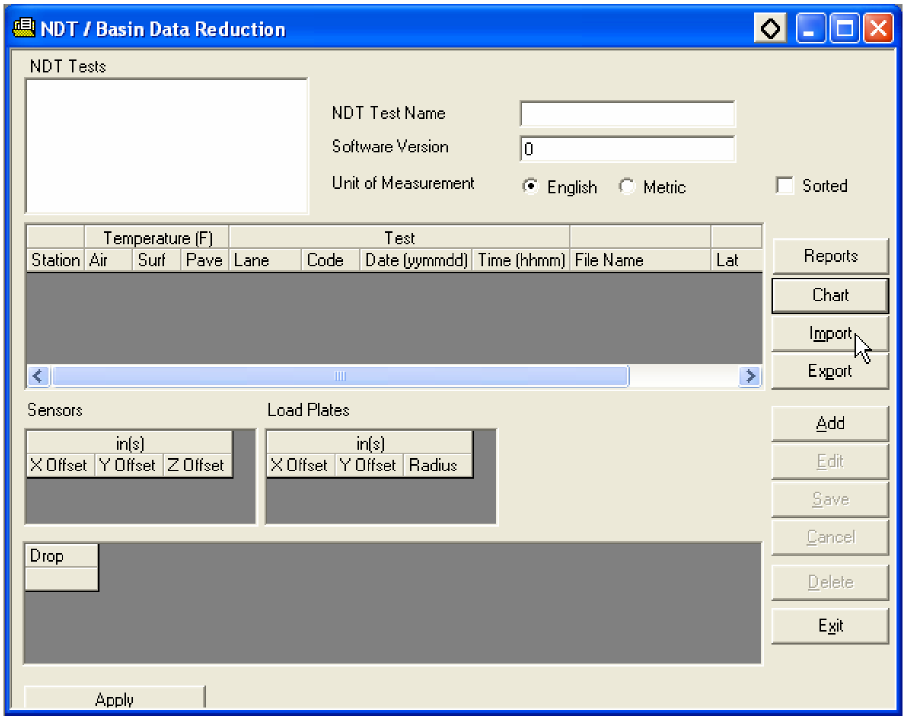


Figure N-3

Select the files to import and click “Open”.

Viewing NDT Data

Once the file is imported the software returns to the opening screen and the data from the FWD file is displayed in the grids as seen in figure N-5.

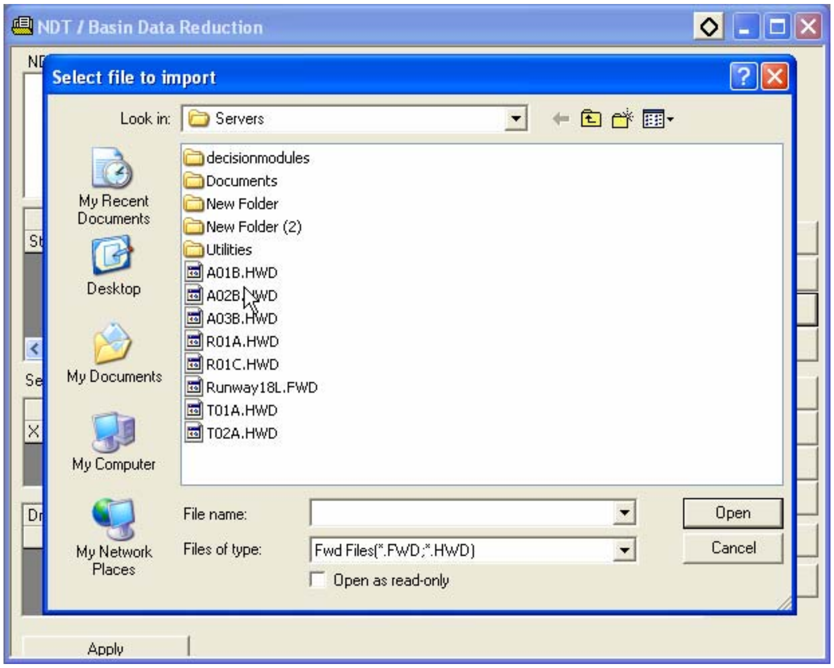


Figure N-4

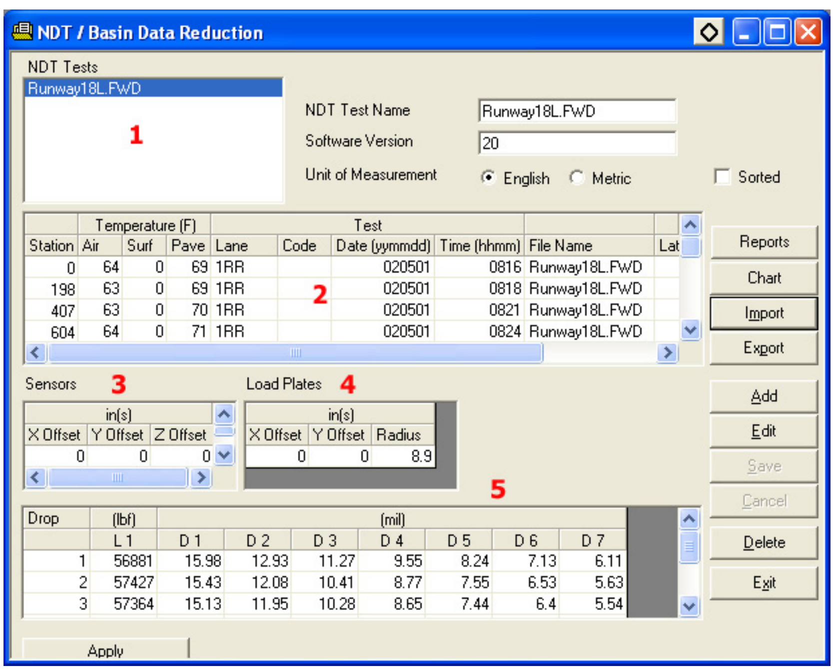


Figure N-5

1 – Imported File Listing – This box displays the files that the user has imported as well as any features that they created from the "Graph" screen.

2 – Station Listing – This grid displays all the stations that were located in the FWD file, along with station specific information such as temperatures and time stamps.

3 – Sensors – This grid displays the sensor setup located in the FWD file.

4 – Load Plates – This grid displays the load plate setup of the FWD.

5 – Drops Grid – This grid displays the drops for whatever station the user has selected in the station grid.

Other Screen Items

Reports – This gives the user the option of printing an Excel spreadsheet of the FWD items.

Chart – This charts the FWD data in a variety of formats. This is the next major step in the NDT Module. See Charting NDT Data in the next section.

Export – This will export the NDT data to an Excel spreadsheet.

Add/Edit/Delete – This gives the user the ability to manually add data to the imported data.

Charting/Graphing NDT Data

The most powerful feature of the NDT module is the ability to chart the FWD/HWD data in a variety of graphs. To chart data a file must already be imported. Once this is complete, click the "Chart" button as seen in figure N-6.

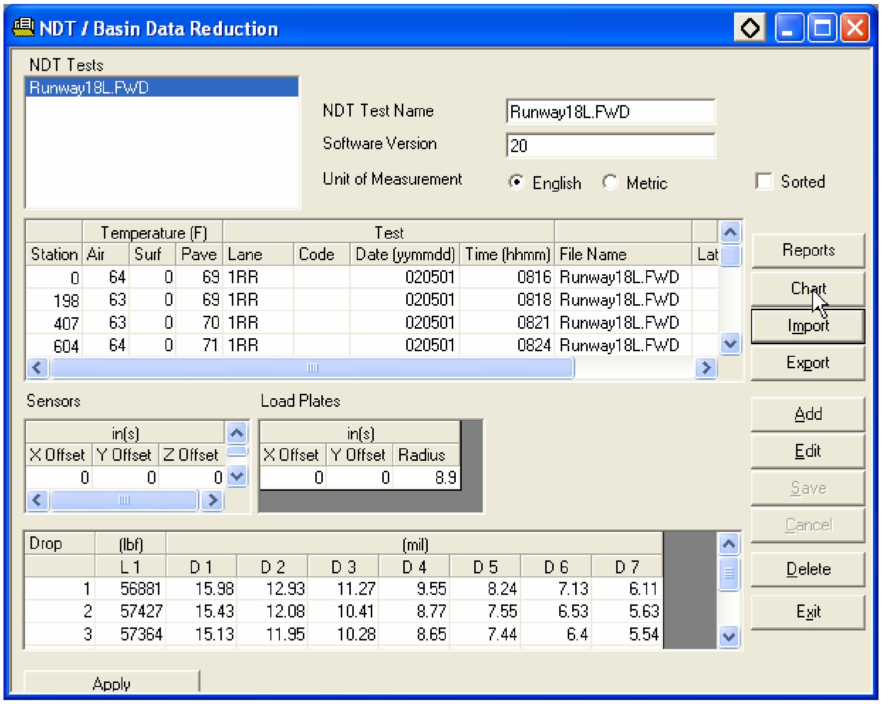


Figure N-6

This will open the charting tool (see figure N-7), with the first imported file automatically displayed in the chart area. The chart that is automatically display is the ISM, or Impulse Strength Modulus Chart, also known as the “Stiffness” chart.

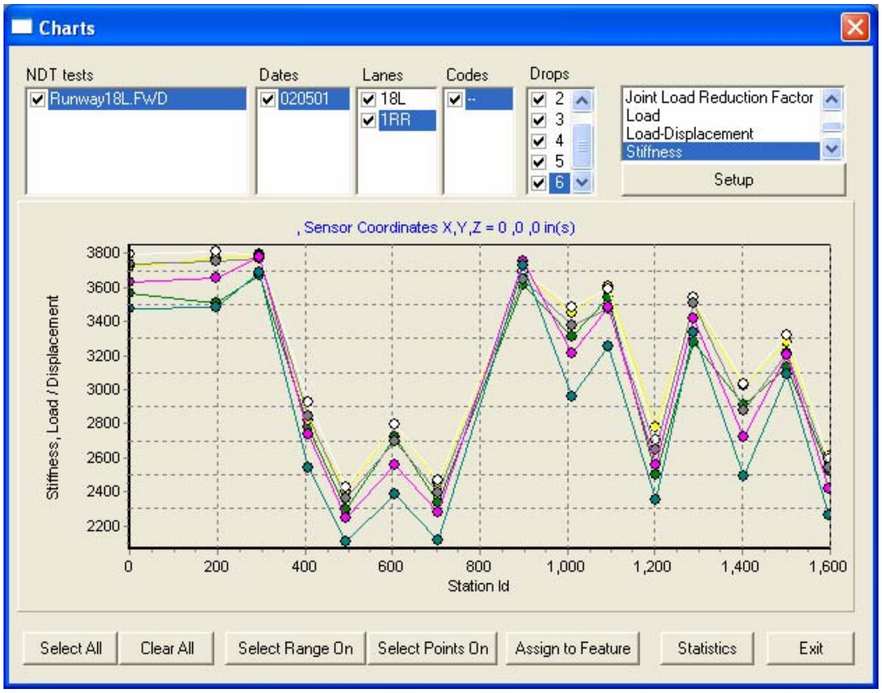


Figure N-7

NDT Tests – This is the list of files the user has imported from the pervious screen. The user can select/deselect files to chart by turning on/off the check marks next to each file in the list.

Dates – Each FWD/HWD file can have multiple dates. The chart tool gives the user the option of displaying stations with only certain dates.

Lanes – Likewise, each FWD/HWD file can have multiple lanes. The chart tool gives the user the option of displaying stations with only within certain lanes.

Codes – Also, each FWD/HWD file can have multiple user defined codes. The chart tool gives the user the option of displaying stations with only certain codes.

Drops – Each station can have multiple drops. The user can select to display only certain drops by turning on/off the check marks.

Chart Options – The upper right corner displays a list of chart options

using the FWD/HWD data. By default the “Stiffness” plot is displayed. Here is a list of the other graphs.
Area – Displays the area underneath the deflection basin as a function of either the X coordinate or Y coordinate.

Basin – This will plot the deflection basin for any selected point(s). To select a point use the buttons at the bottom of the screen. You can select a “Range” of points by clicking “Select Range On” and picking the beginning and ending points in the chart area. Or the user can select “Select Points On” and picking individual points.

Deflection Ratio – This option allows the user to select any two sensors and plot the deflection ratio between them.

Displacement – This allows the user to chart the individual displacement (deflection) readings for any of the sensors.

Estimated Subgrade Modulus – This will use the 72” sensor displacement to estimate a subgrade modulus.

Joint Load Reduction Factor – This allows the user to see the load reduction factor between any two selected sensors.

Load – This plots the measured load for each drop at each station.

Load-Displacements - This will plot the Load vs. Displacement for any selected point(s). To select a point use the buttons at the bottom of the screen. You can select a “Range” of points by clicking “Select Range On” and picking the beginning and ending points in the chart area. Or the user can select “Select Points On” and picking individual points.

Temperature - This will plot the air, surface, or pavement temperatures for the stations.

Volumetric K - This will plot the volumetric K as a function of the X coordinate or Y coordinate.

Using the FWD data to Create Features

One of the main purposes of the NDT tool is to assign NDT deflection data to airfield or road features for use in backcalculation. Typically the user will plot the FWD/HWD data with a "Stiffness" plot and use this stiffness as an indicator as to where to break the pavement into a new feature. For more information on feature definitions see the section within this manual entitled "First Step – Create Retrieve Feature" located in Chapter 3 – Pavement Evaluation.

To break the FWD data into features, first the user must plot the imported data using the "Stiffness" plot. Then using the buttons at the bottom of the screen they should select a range of stations that have similar strength characteristics (see figure N-8).

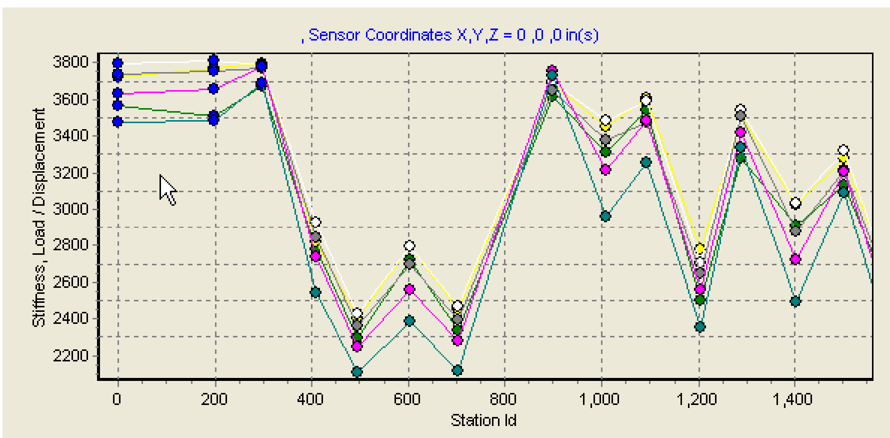
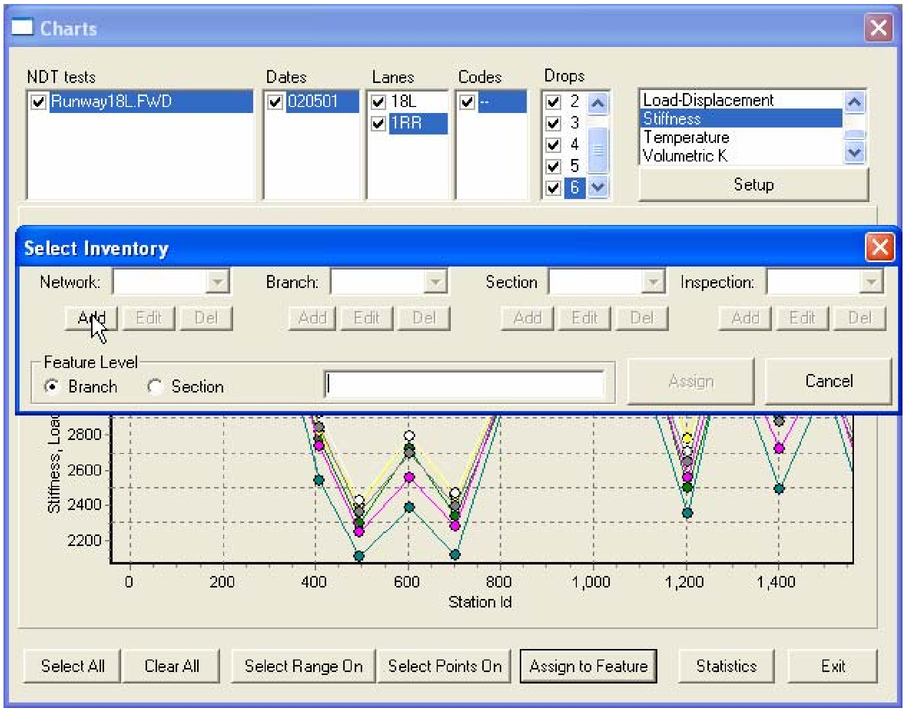


Figure N-8

In this figure the user has selected the first 3 stations as having similar strength characteristics. Now they click the button "Assign To Feature" to assign this data to a feature for their pavement evaluation (see figure N-9). Again, a complete description of features is located in entitled "First Step – Create Retrieve Feature" located in Chapter 3 – Pavement Evaluation.



Charts
NDT tests
Runway18L.FWD
Dates
020501
Lanes
18L
1RR
Codes
Drops
2
3
4
5
6
Load-Displacement
Stiffness
Temperature
Volumetric K
Setup
Select Inventory
Network:
Branch:
Section
Inspection:
Add
Edit
Del
Feature Level
Branch
Section
Assign
Cancel
Stiffness, Load
2800
2600
2400
2200
0
200
400
600
800
1,000
1,200
1,400
Station Id
Select All
Clear All
Select Range On
Select Points On
Assign to Feature
Statistics
Exit

Figure N-9

Appendix R – Evaluation Results Grid

Understanding the ACN/PCN Procedure

Excerpt from UFC 3-260-03 Airfield Pavement Evaluation Page 2-8

UFC 3-260-03 Reporting Allowable Weight Bearing Using the ACN/PCN Procedure Page 8-1

The ACN/PCN is a reporting method for weight-bearing capacity and not an evaluation procedure. The National Imagery and Mapping Agency publishes weight bearing limits in terms of ACN/PCN in a Flight Information Publication for civil and international use. The intent is to provide planning information for individual flights or multi-flight missions which will avoid either overloading of pavement facilities or refused landing permission.

a. The International Civil Aviation Organization (ICAO) (DOC 9157-AN/901 and Amendment number35 to Annex 14) devised the ACN/PCN method as an effective, simple, and readily comprehensible means for reporting aircraft weight-bearing capacity of airfields. The United States, as a cooperating ICAO nation, has agreed to report airfield weight-bearing limits by this method, and the airfield weight bearing limits will be included in evaluation reports.

b. The ACN and PCN are defined as follows:

1) ACN is a number that expresses the relative structural effect of an aircraft on different pavement types for specified standard subgrade strengths in terms of a standard single-wheel load.
2) PCN is a number that expresses the relative load-carrying

capacity of a pavement in terms of a standard single-wheel load.

c. The system is structured so that a pavement with a particular PCN value can support, without weight restrictions, an aircraft that has an ACN value equal to or less than the pavement's PCN value.

d. ACN values will normally be provided by the aircraft manufacturers. The ACN has been developed for two types of pavements, flexible and rigid, and for four levels of subgrade strength.

e. The PCN numerical value for a particular pavement is determined from the allowable load carrying capacity of the pavement. Once the allowable load is established, the determination of the PCN value is a process of converting that load to a standard relative value. The allowable load to use for Army, Navy, and Marine Corps evaluations is the maximum allowable load of the most critical aircraft that can use the pavement for the number of equivalent passes expected to be applied for the remaining life. The allowable load to use for Air Force evaluations is to be based on 50,000 passes of the C-17 aircraft. Criteria for converting allowable loads to PCN values are presented in chapter 8.

f. The PCN value is for reporting pavement strength only. The PCN value expresses the results of pavement evaluation in relative terms and cannot be used for pavement design or as a substitute for evaluation.

ACN/PCN Summary

The bottom line is that for the aircraft the user is evaluating for, PCASE calculates the ACN for them. Based on the type of aircraft, the load of the aircraft and the subgrade strength of the feature, an ACN value is calculated.

The PCASE software also calculates the load bearing capacity of the pavement or feature, using the layer structure information, and reports this as the "Pavement Classification Number" or PCN.

The user can then compare these two values to determine whether the pavement they are evaluating can support the aircraft they are trying to land. The ACN and PCN values are compared to determine an ACN/PCN "ratio" and based on where the ratio falls within the ranges displayed in Figure R-3, a decision can be made on whether the pavement can support the mission aircraft. For example, if the ACN of the mission aircraft is 45 and the PCN of the pavement being evaluated is 55, the ACN/PCN ratio is 0.82. According to the chart in Figure R-1, this ratio is less than 1.0, therefore the evaluation is "green" or full aircraft operations are allowable.

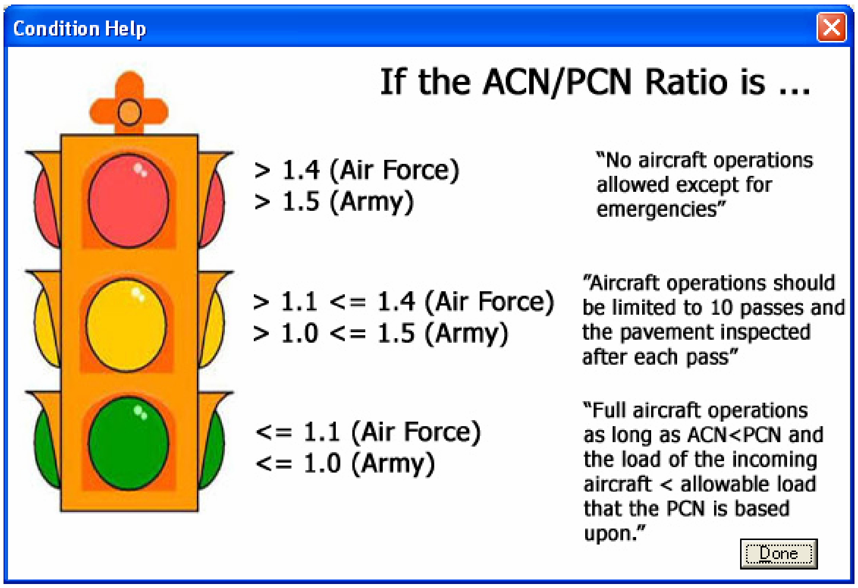


Figure R-1

Results Screen Breakdown

Now that the user has an understanding of the ACN/PCN procedure, figure R-2 is a screen shot of an actual evaluation module results grid. The parts of the results grid are detailed by number below the figure.

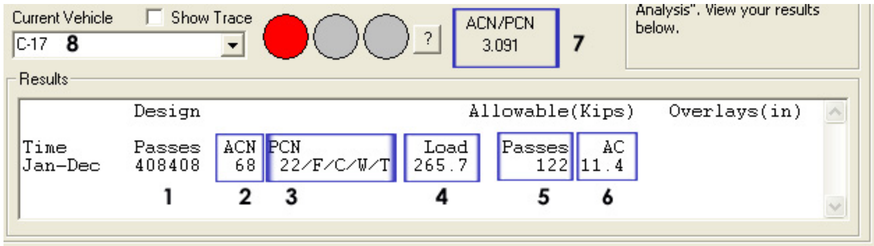


Figure R-2

Figure R-1 - ACN/PCN Evaluation Results Screen in a "Red" condition.

1 – Passes – The passes of the required mission traffic. This pass level comes from the traffic pattern that the user selected on the "Run Properties" tab.

2 – ACN (Aircraft Classification Number) – The calculated ACN value as described in the sections above.

3 – PCN (Pavement Classification Number) – The calculated PCN value as described in the sections above.

4 – Allowable Load in Kips (Thousands of Pounds) – If the ACN/PCN ratio is in the "red" condition, that is that the ratio is > 1.4 for the Air Force and > 1.5 for the Army then the pavement will NOT support the mission as requested. In the example in figure R-1 the user requested a mission of a C-17 at 580000 pounds to land 408408 times. Because the pavement will not support this load, the software tells the user what the pavement WILL support. In this case if the commander was able to lower the load to 265700 pounds (the allowable load), then they would be able to get the full 408408 passes. In Figure R-3 the ACN/PCN ratio is < 1.0 or in a "green" condition, which means that the pavement WILL support the mission aircraft. In this case the Allowable Load tells the user that not only will the pavement support the design load of 580000 pounds, but it will support the design aircraft at 668500 pounds.

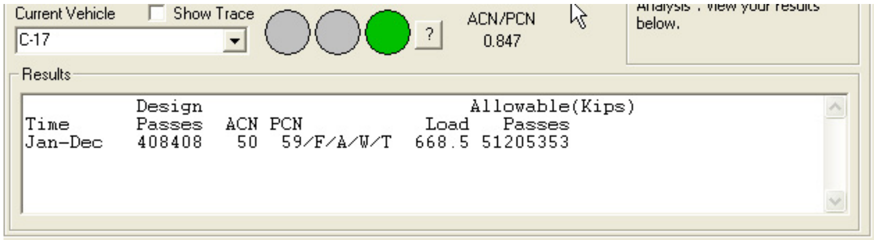


Figure R-3

5 – Allowable Passes – Again, if the ACN/PCN ratio is in the “red” condition, that is that the ratio is > 1.4 for the Air Force and > 1.5 for the Army then the pavement will NOT support the mission as requested. In the example in figure R-1 the user requested a mission of a C-17 at 580000 pounds to land 408408 times. Because the pavement will not support this number of passes at the requested load of 580000, the software tells the user how many passes the pavement WILL support at this load. In this case if the commander had to keep the load at 580000 pounds, then the pavement would only survive 122 passes (the allowable passes). In Figure R-2 the ACN/PCN ratio is < 1.0 or in a “green” condition, which means that the pavement WILL support the mission aircraft. In this case the Allowable Passes tells the user that not only will the pavement support the requested passes of 408408, but it will support up to 51, 205, 353 passes.
6 – Overlay Calculations – If the ACN/PCN ratio is not green, then the PCASE software will calculate the overlay thickness required to make it green.

Appendix T – Building a Traffic Pattern

Opening the Traffic Module

The traffic module allows the user to build the traffic model that will be used on the airfield or road they are designing or evaluating. To open the traffic module click the "Traffic" button in the toolbar (See Figure T-1).

UFC 3-260-03 Ref
"Determine Design Traffic" Page 4-6.
"Airfield Traffic Data" Page 2-4

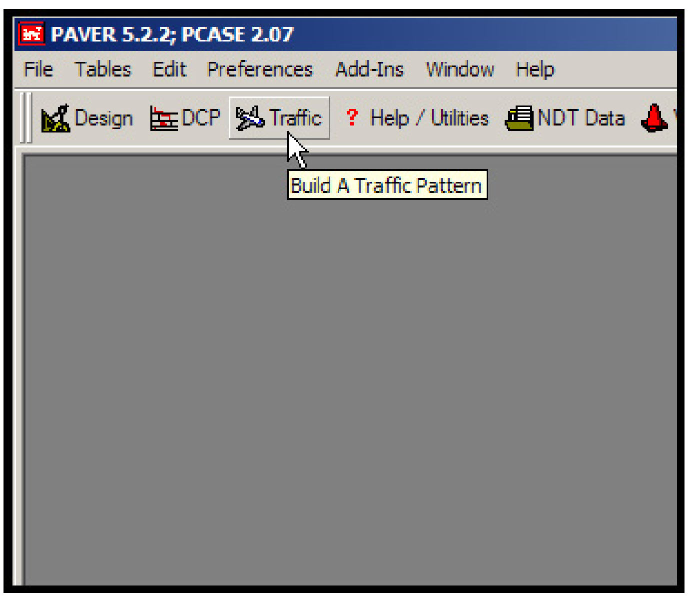


Figure T-1

Once this “Traffic” button is clicked the following traffic building screen will open, and by clicking the “Create Pattern” button that is highlighted in Figure T-2 the initial screen for building the pattern will open (See Figure A-3)

Creating a Traffic Pattern From Scratch

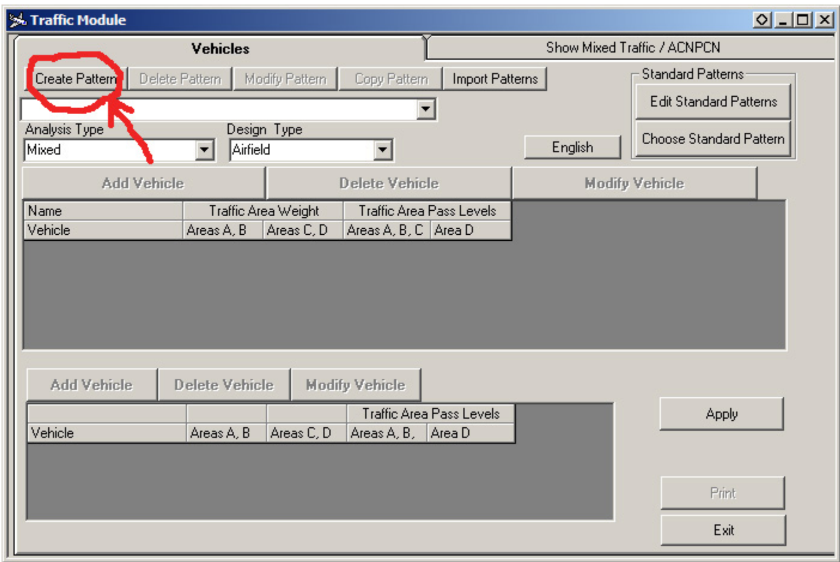


Figure T-2

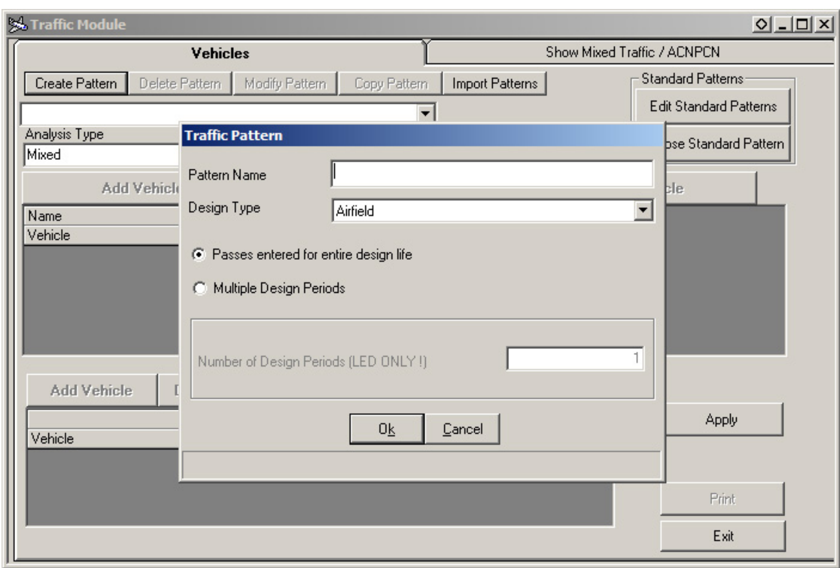


Figure T-3

Pattern Name – This is a user defined name that is given to the traffic pattern to help the user remember what is in the pattern.

Design Type– This is set to either "Airfield" or "Road" depending on whether this pattern will be for an Airfield or Road pavement analysis.

Passes entered for entire design life – This option should be left at the default most of the time. This tells the software that the passes that the user will enter will be for the entire 20 years. For example if the user is designing a runway that will support 2000 passes per year of a C17 and the design life is for 20 years, then the user will enter 40000 passes for the C17 when the traffic module asks for a pass level. If the user had selected "Multiple Design Periods" then they would enter "20" for the number of design periods and then enter "2000" for pass levels.

Adding Vehicles To A Traffic Pattern

One the user clicks "Ok", the user can then start adding vehicles by clicking the "Add Vehicle" button. See figure T-4.

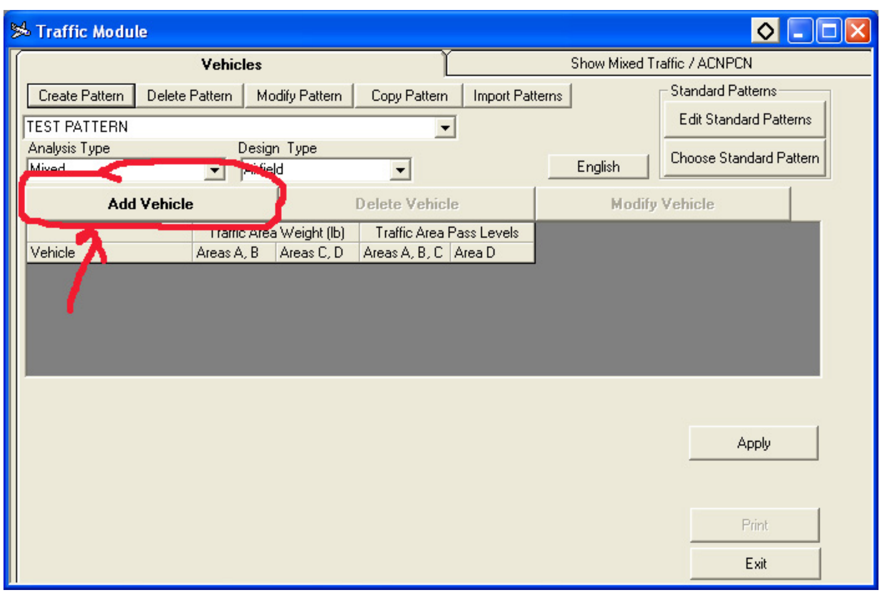


Figure T-4

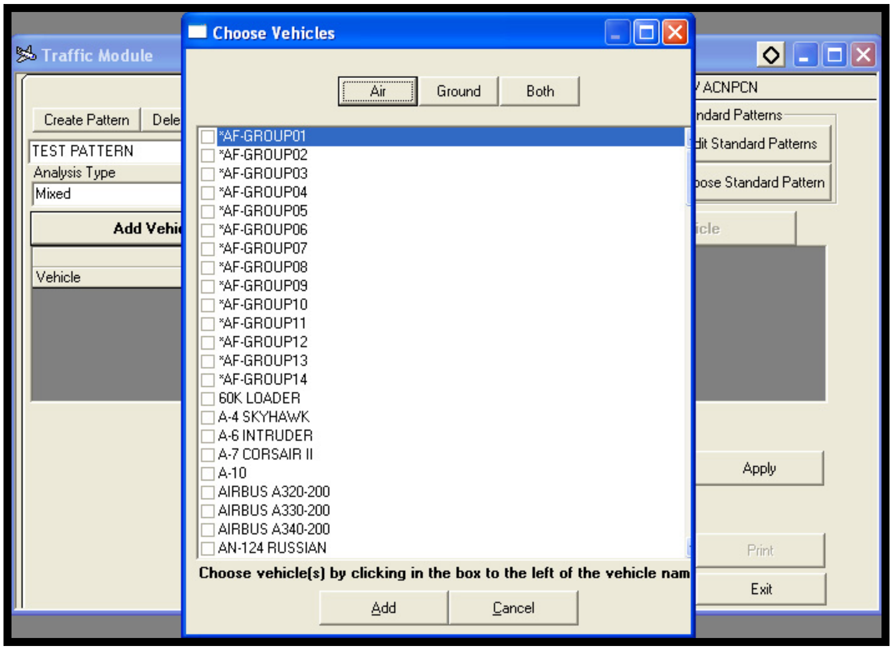


Figure T-5

"Air" Button – This will limit the vehicles displayed to only aircraft.

"Ground" Button – This will limit the vehicles displayed to only ground vehicles.

"Both" Button – This will display all vehicles, both aircraft and ground.

Selecting Vehicles For The Traffic Pattern - To select vehicle(s) for this traffic pattern , the user must put a "check" in the square next to the vehicle name. To do this click inside the square, or "double-click" on the vehicle name. The user can use the scroll bar on the right side to scroll down to see more vehicles. Once all the vehicles have been selected click the "Add" button.

"Add" Button – Once all the vehicles have been selected click the add button to add them to the vehicle list.

"Cancel" Button – Cancel adding vehicles and return to the main traffic screen.

Changing Loads and Pass Levels for Airfield Traffic Pattern

Once the vehicles have been added the user returns to the main screen where they are able to see the vehicles that were selected as well as the default loads and pass levels for the selected aircraft. (See figure T-6 for an example where the C-17, C-130 and C-141 were selected from the vehicle list)

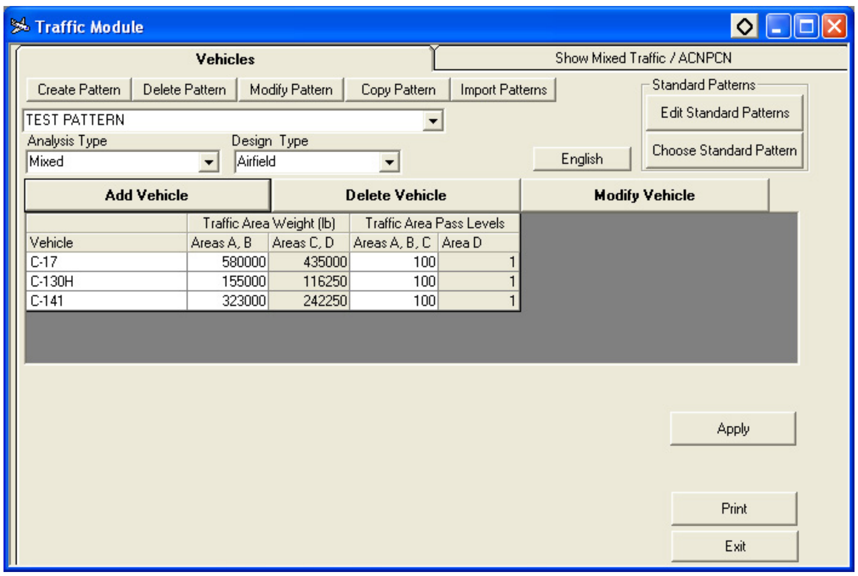


Figure T-6

Traffic Area Weight Column "Areas A, B" – For an airfield pattern used for a traffic area A or B the full weight for the selected aircraft will be displayed in the second column labeled "Areas A, B". This is because if the airfield design or evaluation that is being performed is for a traffic area A or B then the full weight of the aircraft is used.

Traffic Area Weight Column "Areas C, D" – For an airfield pattern used for a traffic area C or D, a reduced weight for the selected aircraft will be displayed in the third column labeled "Areas C, D". This is because if the airfield design or evaluation that is being performed is for a traffic area C or D then a weight that is reduced by 25% is used.

Changing Loads and Pass Levels for Road

Traffic Pattern

Once the vehicles have been added the user returns to the main screen where they are able to see the vehicles that they "checked" as being a part of their traffic pattern. For a road traffic pattern the two columns of interest are the "Weight" and the "Passes". The weight column has the default weight for the vehicle, and the pass level column defaults to 100 passes.

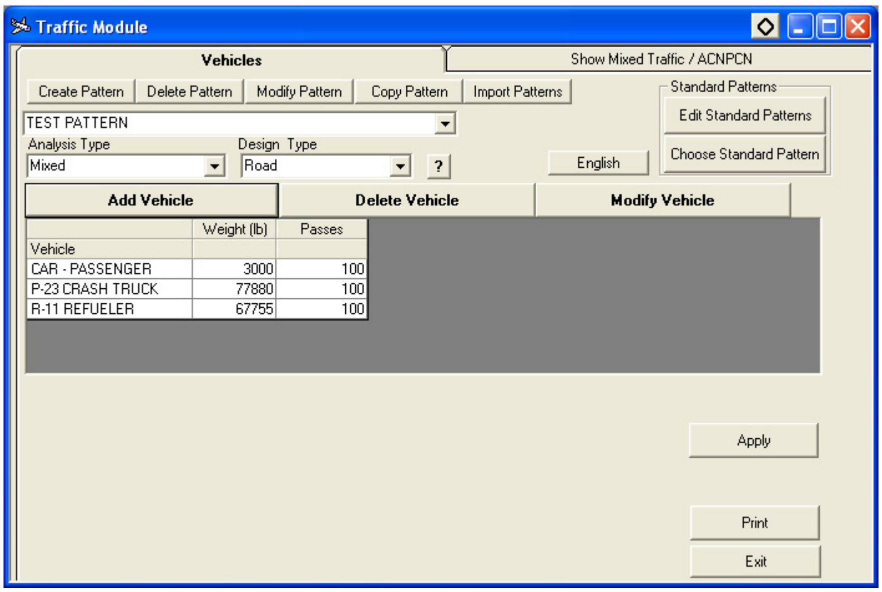


Figure T-7 - Road Traffic Screen

Weight Column – For a road pattern the full weight for the selected vehicle will be displayed in the second column labeled "Weight". The user can override this value and enter the exact weight they expect for this design or evaluation.

Passes Column – Enter the passes expected on this road for the design or evaluation period.

Mixed Traffic vs. Individual Traffic

By setting the "Analysis Type" the user can select how they want to use their traffic pattern in their design or evaluation. The options for analysis type are defined below

"Mixed" - will take all of the vehicles in the database and determine the controlling vehicle and equivalent pass level. At that point only the controlling vehicle will be used for the design or evaluation. Details for mixed traffic analysis can be found in UFC 3-260-02 "Pavement Design for Airfields" on page 10-6. All standard Empirical pavement designs must use mixed traffic patterns. Layered Elastic Designs should use "Individual" traffic patterns.

"Individual" – This type of pattern should only be used for Layered Elastic Designs or Evaluations. This type of pattern will analyze the traffic for EACH vehicle in the traffic pattern.

"Cumulative Group" or "Cumulative Mixed" – This type of pattern should only be used for Navy evaluations.

Using a Pre-Defined Standard Traffic Pattern

The user also has the option of using a pattern that has been "pre-built" such as the "Air Force Medium" design pattern, or the "Army Class IV" design pattern. To select a standard pattern click the button "Choose Standard Pattern" from the traffic screen. (See figure T-8)

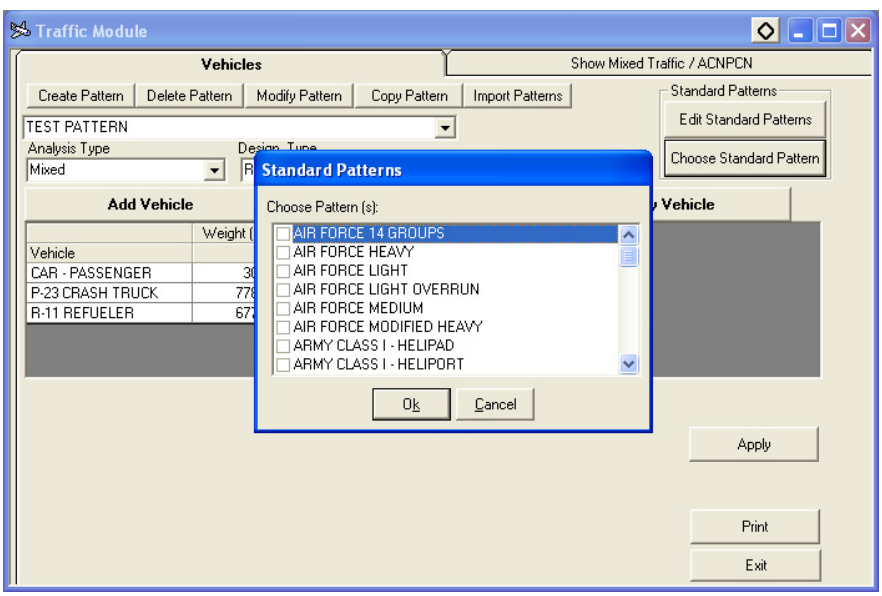


Figure T-8

"Choose Standard Pattern" – The user will see a box like in figure

A-8 allowing them to select a predefined traffic pattern. To select the pattern click in the box to the left of the pattern name and click “Ok”. This will make a “copy” of the standard pattern into the users’ current project. Any changes made to the pattern after it is selected will not be made permanent to the standard pattern list.

Other Traffic Buttons and Options

Delete Pattern – This deletes the current Traffic Pattern from the database.

Modify Pattern – This allows the user to rename the traffic pattern.

Copy Pattern – This will make a duplicate copy of the current traffic pattern.

Import Patterns – This allows the user to import a traffic pattern from another project.

References

UFC Manuals

Airfield Heliport Planning and Design, UFC 3-260-01, November 2001

Airfield Pavement Evaluation, UFC 3-260-03, April 2001

Design of Aggregate Surfaced Roads and Airfields, UFC 3-260-09, September 1990

General Provisions And Geometric Design For Roads, Streets, Walks, And Open Storage Areas**,** UFC 3-230-18FA**,** July 1987

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Subsurface Drainage for Pavements, EI-02C202, October 1995

Airfield Pavement Evaluation Standards and Procedures, ETL 02-19, October 2002

Web References

PCASE Website, http://www.pcase.com

PCASE Computer Based Training – Get training as if you were sitting in the classroom. Take it at your own pace. http://www.pcase.com/cbt/

Tri-Service Transportation Website – http://www.triservicetransportation.com

Glossary

Aircraft Classification Number (ACN): A number that expresses the relative structural effect of an aircraft on different pavement types for specified standard subgrade strengths in terms of a standard single-wheel load. The ACN is numerically defined as twice the derived single wheel load (expressed in thousands of kilograms) at a standard tire pressure of 181 psi, which requires the same pavement thickness as the actual main gear of the aircraft for a given limiting stress or number of load repetitions.

ACN (Flag in Vehicle Editor) - This flag marks the tires used to calculate the maximum tensile stresses in the center (interior) of PCC slabs. It used to calculate the Aircraft Classification Numbers

Airfield Cone Penetrometer (ACP): Probe-type field-expedient instrument that gives an index of soil strength, in terms of an Airfield Index (AI). This AI can then be used to estimate a CBR value. The ACP is a probe-type instrument that when pushed down through the soil gives an airfield index (AI) of soil strength; these AIs are then correlated to CBR values. This instrument is commonly used by STTs for expedient evaluations
because of its portability and simple operation. Its range is limited to 0 to 18 CBR and it will not penetrate many crusts, thin base course, or gravel materials. Consistency of test results is also difficult due to variability of soil strengths that impact the rate of penetration.

Airfield Index (AI): A numerical reading, ranging from 1 to 15 (CBR 1 to 18), taken from an airfield cone penetrometer indicating the strength of fine-grained soils.

Allowable Gross Load (AGL): The load on the critical aircraft that can be supported by the pavement for the desired number of passes.

Allowable Passes: The number of passes of an aircraft operating at a specific weight that the pavement will support before failure.

APE – Airfield Pavement Evaluation, Program that uses CBR methodology evaluate pavements for allowable loads and passes as well as PCN values

ASTM - American Society for Testing and Materials

Base or Subbase Courses: Natural or processed materials placed on the subgrade beneath the pavement.

California Bearing Ratio (CBR): An empirical measure of soil strength used in the conventional design and evaluation of flexible pavement and unsurfaced airfields. To determine a CBR, a dynamic load is applied to a piston whose end is 3 square inches in area, forcing it to penetrate the soil at a rate of 0.05 inch/minute. The load required in pounds per square inch (psi) to force penetration gives the modulus of shear that is converted to a CBR using established load factors. Penetration into a crushed well-graded limestone serves as the benchmark material with a CBR of 100.

Channelized Traffic: Traffic distribution, or pass-to-coverage ratio, is primarily a function of tire width and allowable lateral wander. Channelized traffic areas are those where the aircraft traffic is concentrated in a narrow path with limited (70 inches wide) wander. 'A' traffic areas are designed for channelized traffic.

Compacted Subgrade: The upper part of the subgrade, which is compacted to a density greater than the portion of the subgrade below.

Composite Pavement: A "sandwich pavement" consisting of a rigid pavement overlay placed on top of an existing pavement consisting of a nonrigid overlay on a rigid pavement base. The nonrigid overlay may be bituminous pavement for its full depth or a combination of bituminous pavement and granular material.

Coverage: This term has different meanings for rigid and flexible pavements. For rigid pavements, coverage is a measure of the number of maximum stress applications that occur within the pavement due to the applied traffic. A coverage occurs when each point in the pavement within the limits of the traffic lane has been subjected to maximum stress. For flexible pavements, coverage is a measure of the number of maximum stress applications that occur on the surface of the pavement due to the applied traffic. A coverage occurs when all points on the pavement surface within the traffic lane have been subjected to one application of maximum stress. Thus, a twin-tandem gear would produce two applications of stress on the surface of a flexible pavement, but it would produce only one maximum stress application within a rigid pavement if the tandem spacing was small and would produce two maximum stresses if the tandem spacing was large.

DCP Index: A ratio of the depth of penetration per each hammer blow of the dynamic cone penetrometer (DCP), indicating the strength of soils. This DCP index can be correlated to a CBR value.

Double Bituminous Surface Treatment (DBST): A thin bituminous surface course, often found on less-trafficked areas such as overruns, consisting of a layer of uniform graded stone covered with a layer of bituminous emulsion, followed by a second layer of smaller size uniform graded stone and covered by another bituminous layer.

Dynamic Cone Penetrometer (DCP): A probe-type instrument consisting of a cone-tipped rod that is driven into the soil by a sliding hammer. The DCP provides an indication of soil strength in terms of a DCP index. There is also an Automated Dynamic Cone Penetrometer (ADCP). Several automated versions of the DCP exist. These range from portable ADCPs that require manual lifting of the DCP weight coupled with automated data collection, to those that are truck-mounted and provide automated
DCP operation and automated data collection along with coring capability. The data is analyzed in the same manner as the manual DCP data.

Effective K-value: Rigid pavements are evaluated using the K-value or index of the support provided by the soil immediately beneath the concrete slab. Often, K-values are measured directly on subgrade materials that may then be covered by granular base or drainage layer materials before placing the surface slab. These intermediate layers between the subgrade and the slab provide additional support. The measured K-value of a subsurface layer is converted to an effective K-value based upon the thickness of the intermediate layers to take into account the additional support they provide.

Electronic Cone Penetrometer (ECP). The contingency soils van operated by HQ AFCESA is equipped with an ECP that is hydraulically pushed through the soil layers to depths of typically 5 to 7 feet. The cone tip and sleeve pressures are measured and recorded by the on-board computer system and correlated to CBR values. These measurements also provide the friction ratio which is used in conjunction with the tip pressure to assist in soil classification. This one-of-a-kind item is also equipped with a core drill capable of coring through flexible and rigid pavement layers, is air-transportable by C-130, C-141, C-5, and C-17 aircraft, and provides accurate, consistent data. This van is neither available nor appropriate for all contingency evaluations, but its use should be considered when other methods of data collection do not provide clear results.

Equivalent Single Wheel Load (ESWL): The load on a single wheel with the same contact radius as the gear wheels that will produce the same maximum deflection as the whole gear assembly and at a specified depth within the pavement structure.

Expedient Evaluation: Assessment of airfield structural capability to support 100 passes of a particular aircraft at its maximum weight or the number of passes to support the initial surge of mission aircraft.

Failure Criteria: Condition or degree of distress used in pavement design to identify when a pavement structure has reached its end-of-life or terminal condition, which is referred to as "failure."

Flexible Pavement Failure: A 1-inch rut, measured on the surface, including both the permanent deformation and surface upheaval, but may be caused by failure of any layer within the pavement structure. A flexible pavement may also be considered functionally failed if surface cracking destroys the waterproofing provided by the bituminous surface.

FOD - Foreign object damage

Rigid Pavement Failure: Air Force evaluations are based upon extended-life criteria where 50 percent of the slabs are cracked into approximately six pieces at the end of traffic. This is also referred to as "shattered slab failure." Army evaluations are based upon standard life criteria where 50 percent of the slabs are cracked into two or more pieces at the end of traffic. This is also referred to as "initial failure" or "first crack failure."

Semi-prepared Surface Failure: A 3-inch rut, measured on the surface, including both the permanent deformation and surface upheaval, but may be caused by failure of any layer within the pavement structure.

Shape (Vehicle Editor) – The ratio of the widest axis of the footprint of a tire over the narrow axis.

Feature: A unique portion of the airfield pavement distinguished by traffic area, pavement type, pavement surface thickness and strength, soil layer thickness and strength, construction period, and surface condition.

Flexible Pavement: A pavement with a bituminous surface course and one or more supporting base or subbase courses placed over a prepared subgrade.

Flexural Strength: For Portland cement concrete (PCC), the breaking strength of a simply supported beam that is subjected to vertical loading. Also known as the modulus of rupture, it approximates the tensile strength of the concrete.

FLIP (Flip Chart) - Flight Information Publication

Frost Area Index of Reaction (FAIR): An index of soil strength used in lieu of a K-value to evaluate rigid pavement during thaw-weakened periods.

Frost Area Soil Support Index (FASSI): An index of soil strength used in lieu of a CBR to evaluate flexible pavement during thaw-weakened periods.

ISM – Impulse Strength Modulus, a function of the load applied to the pavement divided by the measured deflection of the sensor closest to the load plate.

K-value (Modulus of Subgrade Reaction): An index used to rate the support provided by a soil layer beneath a concrete (PCC) slab. A K-value is determined during a plate-bearing test by placing an incrementally increasing load on a set of stacked plates and measuring the resulting deflection of the bottom plate. This deflection is corrected for load deformation and plate bending to determine the actual volume of soil displaced under load. The K-value is the proportion of the applied load or vertical stress to the area of deformation and is expressed in pounds per square inch, per inch of deformation, or PCI.

Landing Zone (LZ): A paved or semi-prepared airfield used to conduct operations in an airfield environment similar to forward operating locations.

Lea (Flag in Vehicle Editor) – “Layered Elastic Analysis” This flag marks the tires used to calculate the stresses and strains in a pavement according to the layered elastic theory

LEEP – Layered Elastic Evaluation Program. Program that uses layered elastic methodology to evaluate pavements for allowable loads and passes as well as PCN values

Load Classification Number (LCN): A number expressing the relative effect of an aircraft on a pavement system or the bearing strength of a pavement.

Maximum on Ground (MOG) - Although this term literally refers to the maximum number of aircraft which can be accommodated on the airfield (usually the parking MOG), it is often specialized to refer to the working MOG (maximum number of aircraft which can be simultaneously "worked" by maintenance, aerial port, and others), the fuel MOG (maximum number of aircraft which can be simultaneously refueled) or other constraining factors. It is most commonly expressed in C-141 equivalents.

Non-channelized Traffic: Traffic distribution, or pass-to-coverage ratio, is primarily a function of tire width and allowable lateral wander. Non-channelized traffic areas are those where the aircraft traffic is concentrated in a broader path with less limited (140 inches wide) wander. B and C traffic areas are designed for non-channelized traffic.

Nose (Flag in Vehicle Editor) - To mark those tires that are part of an aircraft nose gear

Passes: The number of aircraft movements across an imaginary transverse line placed within 500 feet of the end of the runway. For taxiways and aprons, passes are determined by the number of aircraft movements across a line on the primary taxiway that connects the runway and parking apron.

Pavement/Aircraft Classification System - The ICAO standard method of reporting pavement strengths. The Pavement Classification Number (PCN) is established by an engineering assessment of the runway. The PCN is for use in conjunction with an Aircraft Classification Number (ACN). ACN values relate aircraft characteristics to a runway's load bearing capability, expressed as a PCN. An aircraft with an ACN equal or less than the reported PCN can operate on the pavement subject to any limitations on the tire pressure. Refer to DOD Flight Information Publication (Enroute) for an airfield's specific PCN.

Pass/Coverage Ratio: The number of passes of a particular aircraft required to produce one coverage of the traffic lane. This is primarily a function of tire width and allowable lateral wander. This number is different for each aircraft due to gear configurations and also varies for rigid and flexible pavement because of the way the loads are distributed in the pavement.

Pcr (Flag in Vehicle Editor) - This flag marks the tires used to calculate the Pass-to-coverage ratio required to convert passes to coverages

Pavement Classification Number (PCN): A number that expresses the relative load-carrying capability of a pavement in terms of a standard single-wheel load.

Pavement-Transportation Computer Aided Structural Engineering (PCASE): A collection of road, airfield, and railroad design and evaluation computer software programs developed by the U.S. Army Corps of Engineers (USACE), written using current USACE criteria and technology.

Pavement Condition Index (PCI): A numerical rating resulting from an airfield condition survey that represents the severity of surface distresses.

PAVER – Software, also called “Micropaver” that allows inputs of pavement distresses (cracks, fuel spills, etc.) and calculates a PCI rating for the pavement.

Permanent Evaluation: Assessment of airfield structural capability to support long-term aircraft

Operations, generally 50,000 passes or more of a particular aircraft at its maximum weight. The results of a permanent evaluation may also be presented as an AGL table that depicts the airfield load-bearing capability in terms of multiple aircraft, divided into 14 aircraft groups.

Rigid Pavement: A pavement consisting of a nonreinforced Portland cement concrete (PCC) surface course resting directly on a prepared subgrade, granular base course, or stabilized layer.

Semi-prepared Airfield: An airfield without a paved (rigid or flexible) surface. The surface may be aggregate, unsurfaced, or stabilized material. The structure typically consists of three layers: the existing subgrade, a subbase, and a base or surface course. A semi-prepared airfield may or may not have a subbase or a base. If the existing material (the subgrade) is determined to be capable of supporting aircraft operations, no subbase or base will be required.

Stress (Flag in Vehicle Editor) - This flag marks the tires used to calculate the maximum tensile stresses at the edge of PCC pavements

Structural Condition Index (SCI): A numerical rating resulting from an airfield condition survey that is calculated based only upon structural or load-related pavement distresses.

Subgrade: The natural in-place soil upon which a pavement, base, or subbase course is constructed.

Sustainment Evaluation: Assessment of airfield structural capability to support sustained aircraft operations. Generally 5,000 passes of a particular aircraft at its maximum weight, or the number of passes required to support the mission aircraft throughout the anticipated operation.

Type A Traffic Area: Area of the airfield designed to support full or maximum weight of the aircraft, with channelized traffic.

Type B Traffic Area: Area of the airfield designed to support full or maximum weight of the aircraft, with non-channelized traffic.

Type C Traffic Area: Area of the airfield designed to support a reduced (75 percent of maximum) weight of the aircraft, with non-channelized traffic.

Unified Soil Classification System (USCS): System developed by the U.S. Army Corps of Engineers (USACE) to group or classify soils based upon particle size, gradation, and plasticity characteristics, and rates their suitability as airfield construction materials.

WESDEF - Backcalculation routine used to determine moduli from a deflection basin. “Waterways Experiment Station Deflection” Routine

WESPAVE – Layered Elastic routine for calculating the PCN, AGL and Allowable passed for a pavement structure. “Waterways Experiment Station Pavement” Routine.

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